TOWARDS REDUCING SUGARCANE PRODUCTIVITY GAP BETWEEN LARGE-SCALE AND SMALLHOLDER FARMERS: INFLUENCE OF ICT AMONG SUGARCANE GROWERS IN SWAZILAND

by

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ABSTRACT

This study evaluates the role of agricultural extension relative to improving information access among smallholder farmers and extension officers with an overall aim of increasing smallholder sugarcane productivity in Swaziland. The country is currently experiencing a decrease in the productivity of smallholder sugarcane growers yet they form a substantial portion of the overall sugar production statistics.

The research process adopted for this investigation involved a theoretical process on one hand, and an empirical process on the other. Both processes followed a systematic investigation pattern. The influence of agricultural extension towards improving sugarcane production and the influence of ICT on knowledge and information management among sugarcane farmers were first interrogated separately. The theoretical approach went on to discuss how well agricultural extension can use ICT to facilitate knowledge and information access among smallholder sugarcane farmers to help them improve their productivity. Drawing from relevant published works, this study was able to establish that agricultural extension, through the use of ICT, is particularly well positioned to assist smallholder farmers with access to sugarcane production information hence improve their productivity.

The empirical process involved data collection through structured interviews with respondents, comprising smallholder sugarcane farmers and extension officers within the sugar industry of Swaziland. A total of 189 respondents participated in the investigation regarding their perceptions on three information access issues: i) barriers to information access; ii) readiness towards the use of ICT to access information and; iii) how information and knowledge is currently being managed. The study generally found that respondents did not perceive most of the barriers to be a hindrance to information access amongst themselves. They also regarded themselves as ready to use ICT, specifically cell phones, to access sugarcane production information. Finally, the study revealed that almost all the respondents have already started using their cell phone to manage information within their workplaces and farms.

Based on the findings, the study then developed a communication model that will make use of the available communication resources to improve information dissemination and management among the sugar industry players. The study concluded by proposing a linkage that will see the government of Swaziland, the sugar industry players and the only mobile network provider in the country (MTN) coming together to support the smallholder sugarcane grower and facilitate the implementation of this model for improved sugarcane productivity.

DECLARATION

This study took place between March 2014 and September 2016, with the cooperation of the University of KwaZulu-Natal, School of Agricultural, Earth and Environmental Sciences, Agricultural Extension and Rural Resource Management Programme and the research participants which included smallholder farmers and extension officers for the entire Swaziland Sugar Industry.

The thesis was written and compiled under the supervision of a solid scholar, Steven Worth who is an Associate Professor in the department of Agricultural Extension and rural Resource Management. He is also the Director for the African Centre for Food Security and an Academic Leader for Teaching and Learning in the School of Agricultural, Earth and Environmental Sciences at the University of KwaZulu-Natal. Except where references have been indicated, this thesis presents the original research study by the author, and has not been submitted in any form to another institution of learning for the purpose of any degree award.

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M.M. Dlamini (Candidate)

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Prof Steven Worth (Supervisor)

DEDICATION

This thesis is dedicated to

My Creator, the ALMIGHTY GOD who through His Grace

Has granted me the ability to pull through this demanding exercise.

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Abbreviations

AFAAS	African Forum for Agricultural Advisory Services
AKIS	Agricultural Knowledge and information Systems
ANOVA	Analysis of Variance
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
DFID	Department for International Development
FAO	Food and Agricultural Organisation
FINCORP	Swaziland Development Finance Corporation
GDP	Gross Domestic Product
GPRS	General Packet Radio services
GPS	Global Positioning Systems
ICT	Information Communication Technology
ICT4D	Information and Communications Technologies for Development
ITU	International Telecommunication Union
MMS	Multimedia Messaging Services
MTN	Mobile Telephone Network
RDAP	Rural Development Area Programme
SACUC	Swaziland Agricultural College and University Centre
SASRI	South African Sugarcane Research Institute
SCGA	Swaziland Cane Growers Association
SMS	Short Message Service
SPSS	Statistical Package for social sciences
SSA	Swaziland Sugar Association
SWADE	Swaziland Water and Agricultural Development Enterprise
UKZN	University of KwaZulu-Natal
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USSD	Unstructured Supplementary Service Data
WAP	Wireless Application Protocol

CHAPTER ONE: GENERAL INTRODUCTION

Background to the study

The success of agricultural research has been viewed by Khang and Moe (2008)) to be affected by a number of influences yet new technologies which emanate from research are needed for improved productivity. They went on to observe that the adoption of these technologies is dependent on a number of factors which include acceptability of the technology as well as its sustainability in that particular area.

Lee Eden and Kalusopa (2005) noted that improvement in agriculture impacts positively towards poverty reduction strategies hence improving people's welfare. This however can only be achieved if there is a functional information delivery system. Information is an important resource for socio economic development as it enable farmers to make accurate choices for improved productivity (Marchionini, 1997).

In the past years, more focus was on instructing farmers on what they must do to improve their livelihoods, however, this has not been able to change the fate of the poor smallholder famers (Cecchini & Scott, 2003). Participatory approaches, as noted by Green (2000) remain the best alternative for improving the productivity of most rural poor farmers and literature has identified a number of these benefits for participatory approaches. Extension officers should therefore work with these farmers on the ground to nature their skills for improved productivity.

In the wake of challenges brought about by globalization, the smallholder sugarcane growers have become a high risk group. Their survival is at stake if proper measures addressing their low productivity levels are not urgently brought into line with levels required to ensure their farming activities are financially, economically, socially and environmentally viable. Increasing the productivity of smallholder sugarcane grower within the context of wider sustainable viabilities (using large-scale growers as a benchmark for technical productivity), smallholder growers will increase their incomes and reduce the vulnerability of their livelihood strategies. Assuming greater productivity translates to increased yields, increasing smallholder production could also substantially increase Swaziland's national

sugar production, thereby bringing additional income for the country at large and to smallholder growers in particular.

The focus of the research was based on the increasing entrance of mobile phones and their subsequent usage by the marginalised population in the rural areas of developing countries (Bhavnani, Chiu, Janakiram, Silarszky, & Bhatia, 2008). One of the ways that can be used by development agencies to reduce poverty among rural people is to improve their communication services. This would result to improved economic and social growth of rural farmers. Recent studies have indicated that the value of mobile phones and its associated benefits are higher among the rural people (Bhavnani et al., 2008).

The prevalence of low cost second-hand phones has made communication to be even more affordable. Currently, Swaziland has s single source of mobile cellular service (MTN-Swaziland) with a geographical coverage of about 90% and a rising subscribership base. The combined fixed line and mobile cellular density is slightly above 60% of the population (Sutherland, 2014). With regard to broadcasting, the country has one state-owned Television station with one channel, however satellite dishes are able to access South African and other international providers. There are also two radio stations, one state-owned, with three channels, and the other one privately owned, with one channel (Sutherland, 2014).

Research Questions

The research conducted explores and addresses the question: How best can the Swaziland extension service, employ ICT especially mobile phones to reduce the persisting productivity gap that exist between smallholder and large-scale sugarcane growers?

Thus the study also addresses the following secondary questions:

a) What are the specific sugarcane production knowledge requirements of the smallholder sugarcane farmers?
b) To what extent is this information on sugarcane production accessible to the smallholder farmer?
c) What technologies would be effective in supporting farmers in acquiring this knowledge?

d) What factors affect/influence the use of ICT among the sugar industry players to improve productivity?
e) How is the practical telecommunication environment in terms of infrastructure coverage and service availability?

Research Objectives

The specific objectives of the study were to:

1) Determine the readiness of smallholder sugarcane farmers and extension officers towards the use of ICT to access timely, accurate and up-to-date sugarcane production information;

2) Identify the barriers towards the use of ICT by farmers and extension officers to access information and knowledge for improved sugarcane productivity;

3) Describe information and knowledge management as it occurs among sugarcane farmers and extension officers for improved productivity.

4) Propose a model for improving information and knowledge access among Swaziland's smallholder sugarcane farmers and extension officers for improved sugarcane production.

Definition of terms

Agricultural Extension is defined as a system that facilitates the access of farmers, their organisations and other stakeholders to knowledge, information and technologies. It facilitates their synergy with associates in research, education and relevant institutions; and help them to enhance their own technical, organisational and management skills and practices (Ian Christoplos, 2010).

Barriers to information access refers to those ICT related factors that make agricultural information not accessible to farmers and other stakeholders who need it to improve productivity (Salau, Saingbe, & Garba, 2013).

Information is data that has been collected, analysed and put into context (Tuomi, 1999).

Information Communication and Technology (ICT) is the assembling of different technologies aimed at managing information to enhance communication and knowledge. It facilitates efficient and cost effective knowledge management (I Christoplos & Kidd, 2000; Zahedi & Zahedi, 2012).

Knowledge and Information management refers to the processes and practices concerned with the generation, attainment, exchange and use of knowledge, skills and expertise (Ethiopia, 2012).

Knowledge stems from information and data. It is information that has been given meaning via interpretation (Chinying Lang, 2001; Tuomi, 1999). Specifically the information and the knowledge referred to in this study is mainly on sugarcane production.

Large scale sugarcane farmer refers to a farmer who own or operates more than 1000 ha of sugar cane growing land.

Mobile phone is a telephone with access to a cellular radio system so it can be used over a wide area, without a physical connection to a network. It is a hand held device that allows users to exchange information through making calls, sending text messages among other features.

Productivity gap refers to the difference in tonnes cane per hector between smallholder and large scale sugarcane farmers.

Readiness for the use of ICT to access information is defined by So and Swatman (2006) as being mentally or physically prepared for some activity. Trinidad (2002) emphasised that it is very crucial to conduct an initial evaluation of preparedness for e-learning among farmers and extension workers before a new technology is introduced.

Smallholder sugarcane farmer refers to a farmer who own or operates less than 1000 ha of sugar cane growing land.

Theoretical framework

Agricultural extension services include transferring knowledge to farmers, advising and educating farmers in their decision making, enabling farmers to clarify their own goals and possibilities, assisting farmers to engage with scientific enquiry and stimulating desirable agricultural developments. A variety of extension programs have been used to achieve the above without much success (Aker, 2011; Anandajayasekeram, 2008; Anderson & Feder, 2004; Worth, 2012).

The main objective of information exchange among the sugar industry stake holders is to facilitate development and narrowing the existing productivity gap that exist between smallholder and large scale farmers. Farmers need to be exposed to the exchange of new ideas for purposes of improving their productivity. The diffusion of innovations theory explains how a new idea gains momentum overtime and spread through a social system until it is adopted (Rogers, 1962). The use of ICT in extension to access and exchange information is one idea that is spreading rapidly among smallholder sugarcane farmers in Swaziland. Its adoption will result in improved information access and exchange thus improving farmer productivity. On the other hand there is the Technology Acceptance model which explains how users of a new idea come to accept and use it effectively. This model suggest that when users are presented with a new idea, a number of factors influence their decisions about the new idea. One of the factors is the degree to which this new technology will enhance their performance. The other factor is their belief that the technology will be free from effort (Davis, 1989). All these theories are centred around the Information Communication Technology for development (ICT4D) theory. The overall aim is to facilitate development among smallholder sugarcane farmers using ICT in rural areas of Swaziland.

With the rise in the demand for agricultural services, many variants of approaches, models and methods have been evolved to connect researchers, extension officers, producers and consumers. However, these service delivery models have been criticized for failing to reach the poor and marginalized farmers in remote villages

ICT in extension has been recognized as a tool necessary for facilitating access to required information and knowledge and it also allows efficient and transparent storage, processing and communication of information even in remote areas (Aker & Mbiti, 2010; Anandajayasekeram, 2008; Chapman, Slaymaker, & Young, 2003; McNamara, 2009; Richardson, 1997). Growth in ICT investment has also been found to be positively associated

with growth in both GDP and productivity of developing countries (Kraemer & Dedrick, 1994).

There is an increasing demand for sugarcane products and, simultaneously a decreasing productivity among smallholder sugarcane growers, who nevertheless contribute a substantial amount of the sugar that is consumed internationally. Both issues demand attention. It becomes counterproductive to seek for solutions to either of the two to the exclusion of the other. Agricultural extension undoubtedly serves as a meeting point for both objectives of meeting the increasing demand by assisting smallholder sugarcane farmers to improve their productivity. This could be achieved, at least in part, by the use of ICT by extension services to facilitate information access by these smallholder farmers. Currently, smallholder farmers are consistently producing at a lower rate compared to the large-scale growers, yet their share of the international market is substantial (Siyao, 2012). Research has identified a number of factors that are responsible for this poor productivity among these smallholder sugarcane farmers. Amongst these factors was poor access to information by these smallholder farmers about sugarcane production. Smallholder farmers most often receive outdated and inaccurate information mainly because the technology they use to access such information is also outdated or not available at all (Mokotjo & Kalusopa, 2010).

In most sugarcane growing countries, sugarcane is produced primarily in the remote rural areas, and this is where poverty is often greatest (Siyao, 2012). Providing resources to improve information access in such areas is a huge challenge. These rural areas where sugarcane is grown lack communication facilities and have poor road networks, high illiteracy rates. As a result the smallholder farmers that are involved in sugarcane production in such an environment end up struggling to produce good yields due to lack of the necessary information and knowledge (Siyao, 2012).

The contribution that agricultural extension can make to synchronise the increasing demand for sugarcane with increasing productivity of farmers via the use of ICT is rarely discussed and remains inadequately explored. Although agricultural extension primarily focuses on enhancing agricultural production, particularly through smallholder farmers, it often, particularly in Southern Africa, follows what is generally regarded as failed extension strategy clearly suggesting a re-evaluation and modification of agricultural extension objectives and approaches (Worth, 2012), such as the use of current technology to disseminate vital information for improved productivity.

The theoretical framework of this study consists of three facets: Barriers to information access via the use of ICT by farmers and extension officers; Readiness of farmers and extension officers towards the use of ICT to access information; and Current information management practices by farmers and extension officers. Previous studies have sought to study these variables in isolation of one another. However, this study employed an interdependency approach; that barriers to information access readiness to information access and current information management among smallholder farmers and extension officers are all linked to one another.

Integrating these three factors to address the challenge of poor sugarcane productivity among smallholder famers so as to meet the increasing demand for sugarcane production is no easy task. This study, however, hypothesises that the use of ICT by agricultural extension could be a viable vehicle towards achieving improved productivity among smallholder sugarcane growers, thus meeting the ever-increasing demand for sugar both locally and internationally. To examine this hypothesis, this research studied the role of agricultural extension in the Swaziland sugar industry relevant to the use of ICT to improve information access among smallholder farmers and extension officers in the context of improving sugarcane productivity. Finally, the study proposes an ICT based agricultural extension service delivery model for the sugar industry of Swaziland.

Importance of the study

The study aimed at assessing the idea of using ICTs especially mobile phones to render timely and accurate information at a lower cost to smallholder sugarcane farmers in order to improve their productivity and eventually their well-being. The study will also determine how ICTs can be used to intensify extension work in such a way that any hindrances brought by long distances between farmers and extension officers can be minimised. During the process, the study will assess both the telecommunication and extension environment as well as the farmer user needs to develop an ICT oriented model that will assist farmers to access information and be able to manage it for improved sugarcane production.

The whole study was carried out in Swaziland with the objective of supporting the country's public and private extension services in their quest to improve productivity and increase yields of smallholder sugarcane farmers by combining the power of communication,

knowledge management and networking offered by existing telecommunication technologies, specifically mobile phones. The study is important in that it explores a unique area of research for Swaziland sugarcane production. The findings will contribute to solving the persisting dilemma of low productivity and loss of potential income by many smallholder sugarcane farmers in Swaziland. And given the similarity of Swaziland's smallholder sugarcane sector to those of other countries in Southern Africa, the study may be of value more broadly.

Research methodology

Because this dissertation is structured around publishable papers, there is no single chapter outlining the research methodology for the entire study. Each chapter presenting data from primary research discusses the research methods followed for the particular aspect of the study covered in that chapter. This section provides a brief, summative overview of the research methods applied to the whole study.

- **Research design**

Research design is controlled by the notion of the fitness of purpose. The aim of the research decides the methodology and the design of the research. Cohen, Manion, and Morrison (2013, p. 78) views it as "an action plan for getting from here to there, where 'here' is the initial set of questions and 'there' is the set of answers. The study was carried out in the Lowveld region of Swaziland where most of the smallholder sugarcane farmers are located. Four enumerators who had recently graduated from the University of Swaziland were hired and trained on how to collect the data.

- **Study population**

For this study, the population consisted of all the smallholder sugarcane growers in Swaziland who currently are actively involved in the sugarcane growing industry and affiliated to the Swaziland Cane Growers Association (SCGA) under the umbrella body of the Swaziland Sugar Association (SSA). The total number of these smallholder farmers who participated in the study was one hundred and seventy two (N=172). Also included in the study were the sugarcane extension officers from different organisations that provide the extension service to the different smallholder farmers. These included extension officers from SSA, SWADE, Government, Suppliers and Financiers. The total number of these sugarcane extension officers was seventeen (N=17); all of them participated in the study.

- **Data gathering methods**

Data in research can be derived from a number of sources including interviews, documents, archival records, direct observation, participant observation, questionnaires etc. (Yin, 2003). A blend of data gathering techniques was used for obtaining data for this study. It was obtained from two different sources which included sugarcane farmers and sugarcane extension officers. Farmers were asked questions regarding themselves. Extension officers were asked questions regarding themselves and the same was done for sugarcane famers.

The study used quantitative research to investigate perceptions of respondents. Primary data was obtained from farmers and extension officers through the use of face to face interviews following a structured questionnaires. The interviews conducted covered issues related to the accessibility and management of sugarcane production information via the use of ICT in the context of improving productivity among smallholder farmers.

Semi-structured questionnaires containing both closed and open ended questions were used for interviewing respondents. Semi-structured interviews contain a mix of more or less structured questions in which specific information is desired from the participants (Merriam, 2002). This process allowed participants to discuss their interpretations of the surroundings in which they live, and to express how they regard situations from their own point of view (Cohen et al., 2013).

Literature review: This is "a process of reading some background information that has been published and appears to be relevant to the research topic" (Bless & Higson-Smith, 1995, p. 22). Previous published research which appeared relevant to this study was critically examined, evaluated and consolidated to establish the parameters and theoretical framework for this study. The literature was used, specifically, to identify and develop indicators that were used to interview the study respondents.

- **Research validity and reliability**

Triangulation was employed in the study to identify similarities and differences in the data gathered from respondents via interviews and observations thus improving the credibility of the study findings and interpretations. A panel of experts was also engaged consisting of two senior extension managers from the Swaziland Sugar Association (SSA), one extension manager from the Food and Agricultural Organisation (FAO - Swaziland) and four academic staff members from the University of Swaziland, department of Agricultural Education and

Extension to review the instrument for content validity. Their recommendations and amendments were incorporated into the final instrument used for data collection in the study. A pilot test was also conducted to determine the reliability of the instrument using cane growers from Vuvulane estates whose characteristics according to SSA are different from the rest of the farmers and they did not participate in the study. Kuder Richardson (KR21) and Cronbach Alpha procedures were used to calculate reliability coefficients of independent variables. Frame-error, selection-error and non-response error were managed in line with suggestions by Miller and Smith (1983). An updated list of all current and active smallholder sugarcane farmers was obtained from the Swaziland Sugar Association (SSA) extension services, thereby managing frame-error. Farmers who appeared on the list yet were no longer growing sugarcane were removed to control selection error.

- **Data Analysis**

Data were collected with a pre-tested schedule. Quantitative data were organised, described, coded and analysed. The Statistical Package for Social Sciences (SPSS) was used to derive descriptive statistics such as percentages, averages and frequencies (Bryman & Cramer, 2002). Descriptive statistics and ANOVA were applied to analyse the data.

Analysis of Variance (NOVA) refers to a statistical technique that assesses potential differences among group means of a scale level dependent variable. For this study a series of ONE-WAY ANOVA were used to determine if demographic variables of sugarcane farmers and extension officers (Age, gender, education, experience, marital status and respondent's category) did affect their responses towards the variables being tested. The one-way ANOVA was used to determine any possible effect of each independent variable on the dependent variables. The null hypothesis of the study was that there is no significant differences on responses due to demographic variables and the alternative hypothesis assumed that there is at least one significant difference on the responses brought about by demographic variables. For testing significant differences, the alpha level was set at 95% ($P < .05$). When the p-value is less than or equal to 0.05, it is said that the categories are significantly different; otherwise it is not. The outcome of this test is important because it will identify those demographic variables of farmers and extension officers which had an influence towards their responses.

Expected outcomes

The key outcomes expected from the study are set out below.

i) Developing a workable communication model that will use the available ICT to facilitate information access for extension officers and smallholder sugarcane farmers to improve their productivity.

ii) Provide the Government of Swaziland, through the department of Agriculture and the sugar industry, with a picture of:

- Any existing barriers that may hinder information access through the use of ICT among extension officers and smallholder sugarcane farmers;
- How ready extension officers and smallholder sugarcane farmers are to start using ICT for accessing sugarcane production information;
- How information and knowledge is currently being managed by both extension officers and smallholder sugarcane farmers; and
- How the scenario described by these three key findings can be improved to enable easier access to sugarcane production information via ICT, thereby improving smallholder sugarcane productivity.

Limitations of the study

The study concentrated on the Lowveld of Swaziland where sugarcane is mainly grown. This makes the findings and the generated conclusions to be specifically more relevant for this region and may not necessarily be readily generalizable to the other regions of the country. However, given the similarities of rural conditions in Swaziland (particularly with reference to ITC and other infrastructure), it should be possible to generalize the study findings and to other smallholder sugarcane farmers of Swaziland.

Further, as the issue of information access affects every farmer irrespective of the type of crop grown by the farmer, the findings of this study may shed light on information access in other commodity sectors.

Due to time factor and budget limitations, this study approach was a once-off study, giving only a snapshot of the current situation – which is highly dynamic. A longitudinal study would have given a much clearer picture of the findings, particularly measuring trends and exploring the real-time effects of information accessed via ICT.

Thesis presentation

This thesis consists of eight chapters in addition to this introductory chapter. Chapters 2-8 are presented as journal articles, of which, Chapters 4-8 present the findings of the study. Chapter 9 is presented in the form of a summary and discussion – consolidating all of the findings of the study.

The published papers are presented in their entirety as published or as prepared for publication. Thus, there is some unavoidable repetition of information and overlaps of themes, and each chapter has its own set of references. The contents of these chapters are as follows.

Chapter 2: A philosophical peer-reviewed journal article entitled, "Agricultural extension in the facilitation of improved sugarcane productivity among smallholder growers in Swaziland: a swot analysis". This paper discusses ways in which agricultural extension can assist smallholder sugarcane farmers to improve their productivity. It starts by discussing the general history of extension in Swaziland, followed by the extension service providers in the sugar industry, and agricultural extension paradigms. Basically the importance of this article is in providing the background information about the sugar industry in Swaziland as well as the current extension practice in the country. This article is a basis for establishing a positive improvement in productivity of the sugar industry players regarding information exchange through extension. This paper was published in the *Asian Journal of Agricultural Extension, Economics and Sociology* [Vol. 12(3), 2016: 1 – 13]

Chapter 3: A paper entitled, "The potential and challenges of using ICT as a vehicle for rural communication as characterised by smallholder farmers"**.** This article discusses the influence of ICT, focusing mainly on how it can be used to improve productivity through knowledge and information management among smallholder farmers in developing countries like Swaziland. The role of ICT in agricultural extension and its challenges are also discussed. This article explains how information and knowledge influences productivity as well as how ICT can be used to enhance the productivity of the sugar industry especially smallholder farmers. The whole research study is focusing on how well the exchange of information among the sugar industry players can improve the productivity of smallholder sugarcane farmers, thereby closing the existing productivity gap. This article is being prepared for submission for publication.

Chapter 4: A paper entitled, "Agricultural extension in the facilitation of information and knowledge access among smallholder farmers through the use of ICT". This paper discusses how information access via ICT in an organisation can be influenced by three factors: (1) knowledge management; (2) organisational readiness towards the use if ICT; and (3) Barriers towards the use ICT. Information and knowledge on their own cannot be of help to a sugarcane farmer unless it is disseminated by agricultural extension services. This article brings in to light how can agricultural extension, theoretically, facilitate information and knowledge access among the sugar industry players to improve their productivity. A diagrammatic illustration is presented to show how the above three factors can be manipulated by agricultural extension to influence information access among the industry players through the use of ICT. The survey results and the proposed model have been developed from these factors. This article is being prepared for submission for publication.

Chapter 5: A paper entitled, "Barriers to the use of ICTs to access sugarcane production information and knowledge in the sugar industry of Swaziland: Perceptions of extension officers and smallholder sugarcane farmers". This article discusses the barriers towards the use of ICTs in accessing sugarcane production information by smallholder sugarcane farmers and their extension officers. This paper is aiming at presenting the existing challenges that prohibit the use of ICT to access sugarcane production information as perceived by the sugar industry players. It is very crucial to first understand the challenges that are facing the sugar industry players before developing something that will provide a solution to these challenges. The information in this article is therefore a basis for developing

solutions to these challenges hence the establishment of the proposed model. This paper was published in the *Asian Journal of Agricultural Extension, Economics and Sociology* [Vol. 21(2), 2017: 1 – 13]

Chapter 6: A paper entitled, "Readiness of the Swaziland sugar industry for the use of ICT specifically cell phones to access information: perceptions of smallholder sugarcane farmers and extension officers". The article discusses the readiness of the Swaziland sugar industry as perceived by smallholder sugarcane farmers and their extension officers on the use of ICTs to access sugarcane production information. This article presents the current and practical position of the Swaziland sugar industry regarding its readiness towards the use of ICT in exchanging sugarcane production information among its players. These survey results form part of the basis for developing the proposed model because you cannot improve something which you do not know its current position. This paper has been submitted and is currently under review for publication in the *South African Journal of Agricultural Extension.*

Chapter 7: A paper entitled, 'Information Management using ICTs Specifically Cell Phones to Access Sugarcane Production Information in Swaziland: Perceptions of Smallholder Sugarcane Farmers and extension officers'. The article discusses how information and knowledge is managed through the use of ICTs, by smallholder sugarcane farmers and extension officers within the sugar industry of Swaziland. The main purpose of this article was to determine how information is currently managed by the sugar industry players. This would enable a better understanding of what is currently happening on the ground so that an accurate approach is developed that will bring a better improvement towards managing information using ICTs. This information has also been used as a basis for developing the proposed model. This article is also being prepared for submission for publication.

Chapter 8: A paper entitled, 'An ICT based Agricultural extension service delivery for the sugar industry of Swaziland: A proposed communication model that accommodates rural smallholder sugarcane farmers'. Based on Chapters 5, 6 and 7 this paper examines the current structural conditions within which sugarcane extension services is expected to promote information access among smallholder sugarcane famers. Thereafter, it proposes an ICT based Agricultural extension service delivery model for the sugar industry of Swaziland. The proposed model has been developed from understanding the Swaziland sugar industry set up discussed in chapter 2 as well as the literature related to the information and

knowledge management in chapter 3. This was followed by a theoretical discussion on how well agricultural extension can facilitate information access through the use of ICT. This information was then combined with the survey results from chapter 5, 6 and 7 to develop a model that can be used to facilitate information exchange among the Swaziland sugar industry players thus improving their productivity.

Chapter 9: This chapter provides a general discussion and conclusion based on the previous chapters, with suggestions for future research. Basically it is a summary chapter that shows how each chapter is linked to the entire research.

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CHAPTER 2: AGRICULTURAL EXTENSION IN THE FACILITATION OF IMPROVED SUGARCANE PRODUCTIVITY AMONG SMALLHOLDER GROWERS IN SWAZILAND: A SWOT ANALYSIS

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Abstract

Sugarcane production, especially among the smallholder growers in the rural areas of Swaziland, has continued to be an area of great concern, not only to the sugar industry, but also to the country's economy as a whole, mainly due to its continued downward trend in terms of productivity. This is further worsened by the different production challenges facing

the sugar industry including economic, production and management challenges. Agricultural extension emerges as the main player in the industry that can bring a positive response towards improved productivity of these smallholder growers. Using the connectivity that exists between sugarcane production and the extension service, this paper presents a philosophical argument exploring the role that agricultural extension can play in the realization of the sugar industry's goal of improving the smallholder grower productivity. Drawing from relevant published works, this paper argues that extension is particularly well positioned to address smallholder sugarcane production challenges through improved teaching and learning, promotion of farmer group formation, strengthening of stakeholder linkages, improved information management and technology adoption.

Keywords: Agricultural extension, smallholder, sugarcane growing, productivity, Swaziland

Introduction

The crucial role of agricultural extension in the social and economic improvement of the country cannot be over emphasised. Never before in the history of Swaziland has the need for training and improving the productive ability of smallholder farmers been of such importance as it is currently, especially in the sugar industry. Improved agricultural productivity relies mainly on the adoption of cultural and technological changes at the grass roots level of the farm.

The sugar industry sector in Swaziland contributes close to 18 percent towards the country's gross domestic product (GDP), 35 percent towards private sector wage employment, and 11 percent towards national wage employment. Sugarcane production is undertaken in the Lowveld part of Swaziland, due to the good soils and the favourable climatic conditions. The crop is grown over a period of 11 to 12 months. Growers can be categorised into four groups: Miller's Cum Planter (MCPs) and estates (77 %), large-scale farmers (17 %), medium and smallholder farmers (6%). While accounting for a smaller proportion of the production, a majority of farmers are categorized under the medium and smallholder grower category. The Swaziland sugar industry produces sugarcane in excess of six million tons per season. Area under cane by grower group indicated that MCPs had 26,283 hectares, large growers had 8,745 hectares while medium and smallholder growers had about 13,831 hectares. These figures increase every year as more sugarcane farmers join the industry (Esterhuizen, 2013).

Thus for Swaziland sugarcane production to improve, farmers have to accept suggested scientific farming approaches instead of their indigenous practices. The slow improvement of smallholder sugarcane growers in Swaziland can be associated to the failure of Swazi sugarcane growers from adopting new technologies. In order to accept new innovations, farmers need to be trained on how well they can implement these new ideas to their farming operations to improve their productivity. New innovations are often complicated, technical and are difficult to comprehend by most rural farmers. Smallholder sugarcane growers in Swaziland can only achieve increased sugarcane production at the farm level through teaching the farmers on basic sugarcane production education, especially the non-formal type that will assist most farmers to move from traditional to progressive farming.

The meaning of the term extension has changed over time and has different meanings in various nations. Rivera and Qamar (2003) define extension as an informal education that is relevant to most institutions that distributes information and guidance with the aim of improving knowledge, abilities and attitudes. Even though the term "extension" is related to agriculture and rural development but it also encompasses the welfare of farmers. It does not matter who performs it, as long as it is done satisfactorily.

The contribution of agricultural extension towards improved sugarcane production among smallholder growers has been debated in most sugarcane growing countries in Africa and abroad but very little has been discussed in Swaziland. Even the very little that has been reported has focused mainly on the old and well known approach of technology adoption which has not addressed the learning and the learning capacity of smallholder sugarcane farmers to improve their productivity (Clowes & Lyne, 2012). Eweg, Pillay, and Travailleur (2009) noted that the challenge of poor performance among smallholder sugarcane farmers was a main issue for most of the SADC region countries. Yield variations between large-scale and smallholder farmers in South Africa often go beyond 50 percent and the reasons for this discrepancy are mainly simulated and have not been proved via research. Furthermore Eweg et al. (2009) continues to suggest that there should be an understanding of the existing smallholder farming systems and a diagnosis of the issues that limit the engagement of new innovations for improved production amongst the countries growing sugarcane in the SADC region. This would help in identifying those areas that need to be addressed. A gap in knowledge and skill between large and smallholder farmers is another area according to Eweg et al. (2009) that must be addressed if the smallholder farmers are to be assisted towards improving their performance.

Emerging approaches to agricultural extension propose a reassessment and improvement of the agricultural extension systems to maximise the productivity of smallholder farmers in such a way that the productivity gap that exist between them and the large scale farmers is reduced. This paper therefore discusses ways in which agricultural extension can assist smallholder sugarcane farmers to improve their productivity. It starts by discussing the general history of extension in Swaziland followed by the extension service providers in the sugar industry and agricultural extension paradigms. The Information Communication Technology (ICT) infrastructure in Swaziland is also briefly discussed and finally the paper suggest ways through which agricultural extension can foster learning and

learning capacity using ICT among the smallholder sugarcane growers to improve their productivity.

Historical Perspective of Agricultural Extension in Swaziland

Agricultural extension in Swaziland was formally organized in the 1930s when the colonial government introduced the agriculture extension service of the Department of Agriculture to produce cash crops, such as cotton and tobacco that provided raw materials for industries in Europe. In the early 1960s the Swaziland Agricultural College and University Centre (SACUC) was established for training of two year certificate graduates in agricultural extension. These were generalist extension workers. In 1965, the Department of Agriculture put forth a strategy for Agricultural Development Areas which aimed at self-sufficiency in the stable food, a strategy which was put in place until the advent of the Rural Development Area Programme (RDAP) in 1970. This programme (RDAP) was established by the Ministry of Agriculture through funds from the World Bank, the United States Agency for International Development (USAID) and the Overseas Development Ministry (ODM) of the United Kingdom.

In the late 1980s, the training and visit system (T&V) was introduced and it led to drastic changes in extension system of the country however the system was later abandoned due to a number of technicalities, and a modified commodity approach was introduced and it's still being pursued by the Ministry of Agriculture.

In 1980, the number of extension personnel was very high with the 'extension-farmer ratio of 1:250 and the corresponding impact was the attainment of self-sufficiency especially in cereal production. However in the 1990s, the impact of extension in production was hampered as the number of extension officers decreased through natural attrition, and officers going for further education and looking for greener pastures. This scenario was worsened by the Government of Swaziland's decision to reduce the civil service by implementing a zero growth among her employees as a strategy for reducing expenditure on labour costs. Currently the public extension service is provided by a few officers with a ratio of 1:1000 (Rivera & Qamar, 2003).

Extension service providers in the sugar industry of Swaziland

Extension services are one of the most crucial factors in facilitating improved performance of smallholder sugarcane growers especially in countries where a large amount of cane supply comes from private suppliers. Extension has a crucial role of maintaining basic production principles of sugarcane production, introducing new technology and guaranteeing that accepted management operations are put in place to protect the industry and the environment (Rivera & Qamar, 2003).

The specific objectives of extension in the sugar industry globally as listed by Meyer, Rein, Turner, Mathias, and Mc Gregor (2011) include but not limited to securing adequate sugarcane delivery, ensuring management of pests and diseases, providing crop management suggestions, maximizing production and sustainability, introducing new improvements and techniques, advising on soil preservation and environment, preparing and monitoring farmers for new laws and regulations, teach farmers on how the industry functions, distribute industry information to users, expedite the use of micro credit for crop improvement, advise on records and management.

Hickey and Mohan (2004) concluded that participatory approaches to planning extension is important because it enables all actors to adopt and disseminate valuable inputs on challenges and opportunities within the wider community. They went to on to advise that the extension model in use should be decentralized in order to cut costs and improve the ownership by the out growers.

The following section describe the organizational set up and functions of all institutions concerned with the provision of advisory services and training to the sugarcane planters of Swaziland. These institutions include Swaziland Sugar Association (SSA), Swaziland Water and Agricultural Development Enterprise (SWADE), Financiers, input suppliers and Government. These organizations have a responsibility to provide solutions to all the challenges that are faced by the sugarcane growers especially the smallholder sugarcane grower that is always less productive compared to the large scale grower.

The sugar industry institutions - This model occurs where a number of millers buy from a pool of out growers with similar interest (Meyer et al., 2011). The Swaziland Sugar Association uses this model to provide extension services to all the sugarcane growers irrespective of their category. The extension function is under the department of technical

services. All the sugarcane growers are affiliated under the Swaziland Cane Growers Association (SCGA). Any extension service by SSA is coordinated through this association and it includes advice on all aspects of sugarcane husbandry, identification of sugarcane production problems and conduct projects to overcome special problems. Extension also arranges seminars, field demonstration, publish newsletters, reports and recommendations (Clowes & Lyne, 2012).

Meyer et al. (2011) noted that industry institutions conduct applied investigations and distribute their output through extension and outreach programs. They also monitor compliance to regulations through extension workers who will visit farmer communities. These extension workers according to Meyer et al. (2011) have an advantage that they are capable of moving thus can assist in the adoption of new techniques effectively. The problem with this model is that it is less demand driven in that officers cannot give guidance when it is needed. Extension workers also do not reside with farmers within the community and the trust level between the famer and the extension worker may be reduced resulting in limited uptake of advised practices.

Industry institutions providing extension to sugarcane farmers are well positioned to use Information and Communication Technology (ICT) to facilitate the smooth and timely flow of information between all the stakeholders. These institutions employ literate people who in most cases are qualified and have experience in both crop husbandry and extension. The use of ICT by such people cannot be a challenge. The industry also has the financial muscle to provide the necessary ICT equipment for information management. These ICT advantages have not been fully manipulated to improve sugarcane productivity among smallholder sugarcane growers. The Swaziland sugar industry has also not yet fully capitalized on these advantages leaving a room for improvement on its information management to improve its productivity.

The Government - Extension services provided by governments are only effective in countries where there is adequate and efficient funding. Government extension service providers are likely to combine sugarcane extension with other crops and livestock and this compromises the level of commitment in as far as sugarcane production is concerned. They are also trained in many subsistence crops and lack technical expertise in sugarcane production unless specifically trained by the industry. With this model there is also less reward for productivity and Governments salary rates are in most cases less than the industry

rates. Extension workers in this model often live within the farmer community and share production ideas with the farmers most of the time. This provides advice to the farmer throughout the life span of the crop and the farmers gain a lot of confidence in the mentorship (Meyer et al., 2011). This model, does not quickly react to the implementation of new techniques and practices since it is not easy to reach individual extension workers. As a result, the level of services expected by the growers and industry is affected. The Swaziland sugar industry has only two extension officers that are hired by the government and their contribution in the sugar industry is very minimal. Due to poor financial backup from government, this model is less effective in the Swaziland sugar industry as extension officers lack means of transport to visit the farmers. Their pay is also not related to their performance. The use of ICT for information management is also compromised due to poor financial backup from government (Clowes & Lyne, 2012).

Commercial Suppliers - Meyer et al. (2011) observed that private companies that supply products or services to the sugarcane growers are also getting involved in assisting their sugarcane growing customers with extension issues. This type of extension is usually product oriented and driven by the commercial interest to maximize the uptake of certain product or activity. Many financial institutions that provide loans to smallholder farmers enter into a tripartite agreement (bank, miller and farmer) to ensure that loans are repaid from source. Moreover, some financial institutions get involved in the provision of extension to these farmers. This reduces the risk to the bank and also improves the profitability of the farmer's enterprise. The Swaziland Development Finance Corporation (FINCORP) and the Swazi Bank are so far the two financial institutions that have hired extension officers to provide extension services to all the smallholder farmers who received finance from them. These extension officers are people who are academically qualified and have a lot of experience in sugarcane production. Other institutions that provide extension services include the input supply companies such as the Swaziland Agricultural Suppliers, Farm Chemicals and many more. The use of ICT in the management of information through this model is very advanced as this organisations are profit driven and the use of ICT helps in the reduction of costs as well as increasing their client base

Approaches of agricultural extension

As Swaziland becomes more concerned about improving sugarcane productivity to increase its contribution to the national economy and improve the standard of living for most

of its poor rural folk through the provision of employment and smallholder farmer development, extension service appear as a strong tool to achieve this. To appreciate the role played by agricultural extension in solving sugarcane productivity issues, it is essential to note the general objectives and approaches of agricultural extension

Agricultural extension has evolved through a number of stages to what it is today. It began from the top down approach (Transfer of Technology model) where emphasis was on the adoption of modern technology developed from research stations. Farmers were not involved in the technology development. Then this approach was followed by the human development concept which aimed at improving human competency through learning and capacity building.

Farmer's participation in technology development later emerged which according to Biggs (1989) aimed at better understanding the farmer's complex environment so as to design technologies that are adapted to their conditions. Later the farmer first concept was introduced with the aim of including the farmer in the process of innovating, checking and assessing technologies to improve productivity especially among smallholder resource poor farmers (Selener, 1997).

In the 1990s, the Agricultural Knowledge and Information systems approach emerged to strengthen information flow in agricultural systems. Röling (1992) noted that an effective agricultural system can only be realized if the different actors in the system (farmers, researchers and extensionists) have a successful access to information and technology. Three broad approaches to extension were identified by Blum (2007) and these were: linear, Advisory and Facilitation. Worth (2006) proposed a fourth approach: facilitated learning. Blum (2007) examined these by engaging eight critical factors that include: purpose, assumptions, source of innovation, promoter's role, farmer's role, supply/demand and target. Table 1 presents a summarised comparison of these approaches using Blum's framework.

Table 1: Comparison of extension approaches.

Characteristics	**EXTENSION MODELS/APPROACHES**			
	Linear	**Advisory**	**Facilitation**	**Learning**
Purpose	Production increase through transfer of technology	Holistic approach to farm entrepreneurship	Empowerment and ownership	Awakening desire and building skills in learning for advancement as jointly defined by partners

	Government policy			
Source of Innovation	Outside innovations	Outside innovations and by farm manager	Local knowledge and innovations	Synergistic partnership of farmers, researchers and extension
Promoter's Role	Extending knowledge	Providing advice	Facilitating	Promoting learning skills and facilitating partnerships for learning
Farmer's Role	Passive: others know what is best Adopting recommended technologies	Active: problem solving Asking for advice Taking management decisions	Active: problem solving; owns the process Learning by doing Farmer-to-farmer learning	Considering all possibilities Contributing to own and others" learning; partner in learning
Assumptions	Research corresponds to farmer's problem	Farmer knows what advisory services he needs	Farmer willing to learn to interact and to take ownership	Farmer less powerful in learning relationship; needs support in developing desire and skill to learn
Supply/ Demand	Supply	Demand	Demand	Supply to evoke dynamic relationship of supply and demand
Orientation	Technology	Client	Process	Client and process and „right" placement of technology
'Target'	Individuals Farmer organizations Projects	Individuals Groups with common problems	Groups and organizations, interaction of stakeholders, networking	Farmers in context of a learning partnership Others in partnership in context of facilitated learning

Source: Abdu-Raheem and Worth (2012)

The linear approach is basically a one way transfer of technology. The technology is developed without the farmer's involvement. The resulting technology is assumed will correspond to the farmer's problems and the farmer is perceived to be a passive recipient of the technology. The advisory approach is also a form of technology transfer where by predetermined technology waits for the farmer's request. The assumption here is that the farmer knows what he/she needs and will ask. Even though farmers participate through requesting information but they are still excluded in the research process.

The learning approach emphasizes on individual and collective learning as a focus of the extension engagement. Worth (2006) proposed that farmers must be involved in real association with research, extension officers, financiers and policy makers for learning purposes. Making the farmers full partners in the research and innovation process will improve their productivity. Innovative farmers in the process will be produced and will be partners instead of recipients of extension programmes (Worth, 2006).

Since extension is basically communication and communication has to do with information dissemination, ICTs are therefore ideal tools that extension can manipulate to

enhance the process of handling and disseminating information. ICTs can also ensure accurate and timely information delivery to target audience for proper decision making. The following is a brief overview of the ICT infrastructure availability in Swaziland.

ICT and extension in the sugar industry of Swaziland

Raising the productivity of smallholder sugarcane growers is an ideal condition for maximising returns and enhancing livelihoods among the rural poor in Swaziland. Smallholder farmers are limited by a variety of constraints many of which are caused by lack of timely and accurate information to make good decisions. Increasing the value of ICT resources available to farmers is crucial in making smallholder agriculture highly productive. The correct placement and utilisation of ICT is central to this improvement and the basic function of extension as explained by Christoplos (2010) remains that of transferring and exchanging of practical information for the farmer to improve his outcomes. McNamara (2009) noted that smallholder farmers encounter higher information costs, due to their isolation as well as the poor state of their ICT infrastructure.

Swaziland has a fairly developed ICT infrastructure. The country has a strong infrastructure for telecommunications and an up to date radio and television network. The country is covered by a GSM 900 mobile network, 3G plus internet service wireless broadband data card (dongle) and other cutting edge ICT network and support tools (Maseko, 2011). The rise of mobile telephone in particular and its associated applications are the most striking examples. The penetration rate of mobile telephone in Swaziland stood at 86 percent as at 2014, a growth of more than 20 percent from the 2009 statistics. However, the penetration rates of other telecom services were very limited (Fixed 5 % and Internet 27%), leaving a significant potential for growth. Swaziland currently has a single source of mobile cellular service (MTN-Swaziland) with a geographical coverage of about 90 percent and a rising subscribership base (Swaziland communications, 2014). With regards to broadcasting, the country has one state owned Television station with one channel, however satellite dishes are able to access South African and other international providers, There are also two radio stations, one state owned with three channels and the other one privately owned with one channel.

Both the Government and the private sector have invested heavily in the ICT infrastructure over the years and these infrastructure makes it practical for a number of ICT

initiatives to be accomplished. However, there is inadequate backbone infrastructure as well as limited production and recording facilities in broadcasting, including development of content. The government of Swaziland is yet to design a master plan for infrastructure development. At the moment, ICT initiatives are undertaken in uncoordinated manner. There is also a lack of strategy on infrastructure sharing resulting in situations where operators build parallel infrastructure on the same route thus making it more expensive for the end user. The government of Swaziland has a monopoly over the telecommunications market and it is leading the way in terms of providing ICT structures, information, systems and capabilities. This then tends to limit advances in accessibility and the greater use of technology, thus, undermining expansion of innovative ICT solutions. The literacy rate of Swaziland according to the World Fact book (2014) stands at 86 percent of the entire population yet in 2008 the literacy rate was 81.6 percent. The country has two official languages which are English and SiSwati. Both languages are used in professional and business life. Thus, Swaziland has a high literacy rate, relative to its size with the most tertiary graduates in the region.

The culture of Swazis regarding knowledge collection and storage was based on oral communication implying that local knowledge was not stored or recorded in technological tools but kept in people's minds and passed from generation to generation through story-telling, songs, poems and other informal ways of teaching. As a result, a lot of knowledge has been lost over the years because of failure to store information especially indigenous knowledge. In addition Maseko (2011) noted that the majority of the older Swazi generation still hold fast to the belief of the traditional ways of conducting business and, thus, still stick to manual processes. They prefer to have both traditional and non-traditional channels of ICT delivery at their disposal and are experiencing difficulties in embracing and adopting new technologies because of their reservations regarding technology. The Swazi population is homogenous in that it has two official languages (SiSwati and English), a common culture and traditions. This homogeneity provides cost saving benefits in a number of areas especially in communication in that there will be little need for interpreters and programming than where the target audience is diverse.

With regards to electricity supply, the Rural Electrification project has played a significant role in ensuring its availability in the rural areas and country wide. It is the Government's policy to increase domestic generation capacity and extend electricity provision to rural communities and also reduce dependency on imports. Electricity outages in Swaziland, however, is still a challenge, particularly in stormy weathers and these undermines the

effectiveness of business related ICTs. Other challenges include the ever increasing costs of electricity however the availability of electricity throughout the country suggest the potential for a higher level of ICT diffusion. Based on this background, the concept of utilizing ICT, especially mobile phones to distribute low cost, timely and useful information to smallholder farmers to increase their ability to increase yield and eventually enhance their earning capacity can be manipulated.

Exploiting extension approaches to improve smallholder sugarcane productivity

Mitigating sugarcane production issues which have a negative impact on both the sugarcane yield as well as the development of smallholder sugarcane farmers is a difficult and a daunting task. Achieving this goal requires a multidisciplinary approach. Agricultural extension as mentioned earlier becomes the meeting point for both increasing productivity as well as the development of sugarcane growers especially the smallholder farmers.

The main productivity issues that were of common interest in the SADC region as identified by Eweg et al. (2009) affecting smallholder sugarcane production were: water; land; cost of production; agricultural extension support. A fifth area suggested were the socio-demographic factors (Eweg, 2005).

A number of attempts have been made by extensionists in the past using different extension approaches to improve sugarcane production and these attempts have yielded less than the expected results. This has required the re-examination of these approaches to determine their shortfalls and hence modify/change them with the ultimate objective of improving smallholder production of sugarcane in Swaziland. In addressing extension's failure to improve the welfare and productivity of resource constraint smallholder farmers, Worth (2006) developed a concept which he called the 'Agriflection model' which is more of a refinement of the facilitation approach to extension. This approach emphasizes on the learning aspect of extension intervention mainly among three participants which are Farmers, Extensionists and 'Enablers'. Extension has a responsibility to foster learning and learning capacity among the farmers.

The role of extension according to Worth (2006) in driving the learning process would be in the development of options that the farmer will use to address problems and opportunities as well as increasing the capacity of the farmer to command the learning

process. This then implies a move according to Worth (2006) from a technology dominated paradigm to a farmer learning dominated paradigm where the primary concern is not technology adoption but rather creating an environment aimed at building the capacity of the farmer to engage in scientific enquiry.

The following are options that can be used by extension to drive the learning process thus addressing the sugarcane productivity challenges in an attempt to increase the capacity of the famers to command the learning process. These options include: teaching and learning; promoting farmer group formation; enhanced information management; strengthening stakeholder linkage and facilitating technology adoption.

Improved teaching and learning

One of the many instruments that can be used by sugarcane extension to improve sugarcane production by smallholder farmers is education (teaching and learning). Training programmes can be implemented through a combination of various extension methods including; workshops, field trainings, field visits and demonstrations (Abdu-Raheem & Worth, 2012, p. 48). Training of sugarcane farmers becomes easy when they are in groups. The cost of travelling from one farmer to another is reduced and information is uniformly distributed to all of them. The use of different teaching techniques such as demonstrations and use of multimedia to explain a concept is also made easier. What makes it even more effective is the fact that these farmers are a homogeneous group since they all grow sugarcane.

The success of any programme according to Coutts, Roberts, Frost, and Coutts (2005) depends entirely on the quality, attributes and abilities of designers and executors. For the sugar industry to add its share to the economic development of the nation, local institutions with skilled man power are important. Improved sugarcane production needs a sizable number of extension agents and farmers whose capability is improved to conceptualise and provide solutions to sugarcane production issues.

A good knowledge of an intervention coupled with education does affect the eagerness of a person to be involved in collective action that will bring about collective gains (Pierotti & Wildcat, 2000). One of the ultimate objectives of an extension system is to enhance a well-trained and motivated staff that will accommodate a different actors along

identified value chains in the sugarcane production process. A key problem that is currently facing the sugar industry and has seriously influenced the productivity of farmers is the shortage and poor quality of employees.

Adoption of an innovation comes through a learning process in two phases (Ghadim & Pannell, 1999). The first one being the collection, integration and evaluation of innovations to make informed decision about that new innovation. The second phase is development of the farmer's skill to better incorporate new innovations to their local situations. The first phase shows that farmers are not sure about the rewards of a new innovation and as such are not willing to adopt it. Their uncertainty is only reduced after they have been educated and it is then that they can make informed decisions regarding the new innovation. The other aspect of the learning process assumes that an innovation can only be implemented when the farmer has some degree of background information about the innovation (Marra, Pannell, & Ghadim, 2003).

A Study conducted by Ssekiboobo and Muwanga-Zake (2013) noted that poor ICT training among extension staff in poor nations decreases their ability of collecting and handling of agricultural data and services to meet data user needs. All stakeholders associated with extension service delivery should be well financed and trained for professional characteristics in order to improve productivity. These trainings must be scheduled and implemented at different stages of the extension personnel to ensure success and sustainability of the sugar industry in Swaziland.

Promoting Farmer group formation

Smallholder sugarcane farmers in Swaziland have grouped themselves into farmer's associations, farmer's cooperatives, or companies. Currently this sector comprises of registered growers in excess of 160 with large portion of them registered as farmer groups. This number however fluctuates every year as some new farmer groups join while others move out (Swaziland Sugar Association, 2016). Farmer groups are very essential for the growers because they allow growers to combine their operations that are either too small or too big for individual growers. This improves the level of commitment, motivation, skill development and cost effectiveness. It also enables groups to receive free or subsidised assistance from different institutions (Sifundza & Ntuli, 2001)

One area that has been advocated for many years but with very little attention accorded to it has been on assessing whether smallholder farmers do understand the rationale behind the formation of these farmer groups, how to go about doing it and what criteria should be used to select people. At the end of the day, groups are formed and only to dismantle within a short time after formation and the reason being that there was no thorough teaching and learning among the farmers so that they understand what they are doing. Internal disputes are a common reason for most farmer groups to dismantle and the extension service has to ensure that these groups are taught how to handle disputes. Gray, Phillips, Dunn, Shulman, and Price (2000) indicated that farmers' choices on land use are greatly dependent on the interconnection among the farmers themselves and the general social context of the community in which decisions are being taken.

With extension promoting farmer group formation in the course of improving sugarcane productivity among the small sugarcane farmers, awareness of new farming systems among these farmers could be guaranteed. The adoption of any program aimed at improving the productivity of smallholder sugarcane growers can be made easy among all stakeholders concerned including the mill, financiers, SSA, input suppliers and many others. Gray et al. (2000) noted that the formation of farmer groups within a society ensures a good opportunity of effectively accepting an innovations at a general scale to achieve collective results and benefits. Collective resources that can be pulled together through the use of farmer group formation in a community include natural resources, physical resources, human resources and information resources (Stanley, Clouston, & Baker, 2006).

Improving Information Management

According to Meyer et al. (2011) information is one of the most valuable resources for improving productivity among smallholder sugarcane farmers and extension is ideally positioned to facilitate its free flow within all the sugar industry stake holders. Correct and timely information can help smallholder sugarcane farmers in quality decisions and taking appropriate action. To facilitate development and hence improve productivity, important information needs to be made available and accessible through the use of ICT particularly to the smallholder sugarcane growers. Burton-Jones and Hubona (2006), argued that the challenge with most underdeveloped communities is that the farmers are not aware of what type of information they need. They further do not know what information is at their disposal

to help them solve their challenges. This is where extension comes in to assist the farmers through education and the facilitation of information availability and accessibility to these farmers. The strengthening of linkages by extension among the sugar industry players also enables the free flow of vital information for improved productivity especially among the disadvantaged smallholder sugarcane farmers. The availability of communication infrastructure, especially in the rural areas where most of the smallholder growers are located should be a priority for the government if productivity is to be improved. Extension again has a responsibility to engage all the actors in the sugar industry with an objective of educating them on the use of ICTs to manage information.

Strengthening Stakeholder linkage

The current level of coordination among the sugar industry stakeholders in Swaziland is not very good as some stakeholders are working independently of the other. The different institutions (Government, Suppliers, Finance, SSA, etc.) tasked with rendering advisory services to the farmers, do so independently of the other yet all of them are targeting the same farmer growing the same crop. This then opens an opportunity for contradiction, repetition, and competition which eventually leaves the poor farmer confused and not sure which direction to take. Linking these stakeholders so that their activities are coordinated could improve the performance of the industry.

Therefore, another mechanism of extension through which sustainable sugarcane production can be improved among smallholder sugarcane farmers is the establishment of a sugarcane stakeholder linkage. This means that extension must assist smallholder sugarcane farmers to arrange for a vertical integration with both downstream and upstream organizations and also establish a horizontal integration among people of different interest groups within the sugar industry. This involves the establishment of a network of people with the same vision and goal. The linkage entails that extension should create a working relationship among the industry players, groups or organisations for the sole purpose of maximising productivity. Extension has to start by educating each of these groups about the importance and the benefits of forming a linkage among themselves. For example financial institutions that offer loans to the famers can be linked with the millers that buy the sugarcane from the farmers so as to assist the rural farmer to easily pay the debt. Farmers can also secure favourable deals from input suppliers including discounted prices and free/subsidized

delivery services. Swanson (2006) concluded that extension is well positioned to educate and establish these linkages with the relevant stakeholder groups.

Facilitating technology adoption

Sugarcane research activities would have no value if the results are not made known and adopted by the sugarcane farmers (Julien, 1997). The promotion of Good Agricultural Practices (GAPs) developed by research and the subsequent adoption of same by the sugarcane growers enables them to achieve competitiveness and sustainability. A strong research-extension-farmer linkage is very crucial in the development and subsequent adoption of appropriate technologies by sugarcane growers to improve their productivity.

In most instances, smallholder sugarcane growers are often neglected when it comes to research and all the research output is directed and adopted by large scale growers. Extension has a responsibility to facilitate technology transfer for adoption by the industry players including the smallholder sugarcane growers. The Swaziland sugar industry relies mainly on the South African Sugar Research Institute (SASRI) for the training of their employees and for most sugarcane research output. The SSA through its technical services department conducts minor research locally. Most of the new research outputs released by SASRI are then taken up by the sugarcane extension personnel and disseminated to smallholder sugarcane farmers.

The SWOT analysis of the Swaziland sugar industry

The major strength of the sugar industry extension lies in the high educational background and experience of its extension personnel which translates to efficient cane production mainly from the large scale producers. This is further improved by attractive markets where the Swazi sugar is sold. The strategic multifaceted role played by the long-time existing sugar industry in the economy of Swaziland has enabled it to receive special attention and help from Government and this has been the reason why smallholder cane growing has received particular policy attention.

Against these strengths, several weaknesses that threatens the future viability of this industry have been observed which include the ever increasing costs of producing cane coupled with the weakening efficiency of sugarcane production by smallholder farmers especially the new ones who have just joined the industry. Poor stakeholder linkage within

the system has encouraged each stakeholder to operate independently of the other, thus compromising the benefit of a joint effort. Poor adoption of new technologies by smallholder farmers is another weakness mainly due to lack of accurate, reliable and timely information dissemination for effective decision making. The high costs and inefficiency of transportation is another critical factor affecting the cost reduction of the industry. These weaknesses are the reasons why smallholder sugarcane production must be given the necessary support from all the stakeholders for its sustainability and improvement.

Several opportunities lie within the sugar industry for extension service to manipulate including the possibility of taking advantage of the ICT supporting infrastructure in Swaziland to improve information knowledge and dissemination among the industry stakeholders. The country has a well-developed network for radio and television usage. It is also covered by a GSM 900 mobile network, 3G plus internet service wireless broadband data card (dongle) and other cutting edge ICT network and supporting tools. The use of such infrastructure could lead to an improved productivity, efficiency, and competitiveness among smallholder farmers.

The biggest threat facing the sector is that of climate change which has a huge impact on the productivity of smallholder sugarcane growers who in most cases lack accurate and timely information for proper decision making. Failure of smallholder farmers to run their farms efficiently is another threat which has led to low returns on investment. Further the HIV/AIDS pandemic has also threatened to impact negatively on the productivity of farmers as most of them get infected or affected by the virus.

Conclusions and recommendations

Through agricultural extension, improved sugarcane productivity among smallholder sugarcane growers can be achieved. The different means that can be employed by agricultural extension to foster learning and learning capacities using ICTs include farmer group formation, strengthening stakeholder linkage, improving teaching and learning, facilitating technology adoption and enhancing free flow of information. Extension is basically communication and communication has to do with information dissemination; ICTs are

therefore ideal tools that extension can manipulate to enhance the process of handling and disseminating information hence assisting smallholder farmers to improve their productivity.

Agricultural extension should therefore be an integral tool of all the industry stakeholders that provide extension services to address the issue of low productivity among the smallholder growers. The different approaches of extension that are at the disposal of the extension service personnel within the sugar industry of Swaziland, can be exploited to improve the way in which extension services are delivered there by improving the productivity of smallholder sugarcane growers. Irrespective of which approach or combination of approaches are being used (technology transfer, advisory, facilitation, or learning) to address farmer's challenges, agricultural extension programs should be adjusted so that they contribute towards improving the productivity of smallholder sugarcane growers. Different institutions providing sugarcane extension service in Swaziland have been identified to facilitate improved performance among smallholder farmers however there is a need to coordinate their services in such a way that their message is delivered with one voice to the farmer. The use of ICT in this regard as discussed could improve the service delivery to the farmers.

Since the sugar industry of Swaziland is an organised entity guided by an act of parliament, the Swaziland Sugar Association in partnership with the Government of Swaziland are better positioned to facilitate the coordination and the subsequent implementation of the above.

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CHAPTER 3: THE POTENTIAL AND CHALLENGES OF USING ICT AS A VEHICLE FOR RURAL COMMUNICATION AS CHARACTERISED BY SMALLHOLDER FARMERS.

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Abstract

Agricultural extension is a communication network linking different stakeholders in agriculture to improve their productivity and ICT has been utilised as an extension tool for enhancing information flow between agricultural extension services and their clients. The application of ICT in agricultural extension and rural development has significantly increased in several countries where it has provided an adequate access to agricultural information.

Efforts are, therefore, needed to scale up investments in physical ICT infrastructure and services across developing country. This could be realised through the implementation of interventions aimed at speeding up assimilation and adoption of improved agricultural technology and management practices of the less productive smallholder farmers. Drawing on relevant published works, this paper argues that agricultural knowledge and information management within an extension system can improve productivity of smallholder farmers. The role of ICTs in agricultural extension is discussed together with its challenges towards the improvement of productivity among smallholder farmers. Smallholder farmers need to develop and utilize ICT based knowledge management techniques to implement strategies and interventions to transform the agricultural sector and improve their productivity.

Key words: Knowledge, ICT, Extension, Swaziland, productivity, sugarcane.

Introduction

One of the primary functions of an agricultural extension service is to disseminate knowledge and information to farmers (Richardson, 2005). Knowledge and Information can be disseminated in many forms such as printed materials, radios, television, cell phones, group discussions, individual visits and all of these are routinely included in the communication strategies of extensions services however there are some challenges that hinders the delivery of agricultural extension services. These challenges include; the inability to relay knowledge and information on time; farmers having difficulty to access knowledge and information directly; costs and logistics of knowledge and information dissemination; Inability to reach masses as well as the commonly used top down approach system of knowledge and information dissemination. The advent of ICTs presents a new opportunity for the extension service to overcome all these challenges in their quest to effectively disseminate knowledge and information.

Information communication technology (ICT) is the assembling of different technologies aimed at managing knowledge and information to enhance communication. ICT holds the potential to enhance decision-making in agriculture thus influencing the effective management and success of agricultural organizations – including farmers. It also connects the world, dramatically changing lifestyles. Technology also provides an opportunity to under developed nations to establish strategies for competing with their developed counterparts (Zahedi and Zahedi, 2012).

Recent studies have shown that agricultural extension should be looked at as a communication network linking different social actors (Leeuwis and Van den Ban, 2004). ICT has been utilised as an extension tool, which has enhanced the knowledge and information flow between agricultural extension services and their clients. The application of ICT in agricultural extension and rural development has significantly increased in several countries where it has provided a medium to adequate access to agricultural knowledge and information (Richardson, 2005). Extension workers have a direct link with farmers and other actors, and thus are well positioned to make use of ICTs to access modern knowledge and information that could assist farmers to improve their productivity (Jones, 1997)

Purpose of article

ICT should serve as a repository of knowledge and information created by researchers and farmers; and also a platform for experience sharing so that more smallholders can benefit from it. This would undoubtedly strengthen the research-extension-farmer linkage and also enable the flow of up to date knowledge and information among the stakeholders. The role of the extension worker would be improved from transferring technology packages to that of transferring knowledge and information packages. Extension activity of this kind will be more knowledge intensive and more effective as it meets the timely knowledge and information needs of farmers. Furthermore, access to ICT service will enable extension workers to engage in the full knowledge management activity and be in the position to gather, store, and disseminate knowledge and information that are demanded by farmers. The purpose of the article is to establish the value of ICT in extension and to explore the challenges in implementing an ICT strategy. The article also discusses how knowledge and information is managed in agricultural extension as well as the role of ICT in the dissemination of agricultural knowledge and information in extension.

Exploring ICT in agricultural extension

To make informed decisions in the agricultural industry, according to Zahedi and Zahedi (2012), participants require bringing together, processing and manipulating data. Agricultural decisions such as timely land preparation, planting, weeding, irrigating, harvesting, storage and marketing are central concerns to agricultural stakeholders. The agricultural workforce requires greater technological skills than before. ICT supports new methods such as precision agriculture which uses computerized farm machinery to apply fertilizers and herbicides, and other computerized technologies to buy and sell online and many electronic technologies for other pre- and post-harvest operations. However, despite the growing popularity of such ICT-supported operations, the most important role of ICTs remains communication (Zahedi and Zahedi, 2012).

Effective agricultural development requires access to information on all aspects of production, processing and marketing. ICT shows potential to play that role in the [two-way] delivery of information in both developed and developing countries (Zjip, 1994). In the context of agriculture, the potential of ICTs can be assessed broadly under two categories: (a) as a tool for direct contribution to agricultural productivity; and (b) as an indirect tool for

empowering farmers to make informed and quality decisions, which positively impact on the way they conduct agricultural activities. (FAO, 2006).

Differences between data, information and knowledge

The term knowledge has often been used interchangeably with information and data, yet these are different.

Data denotes a combination of records of figures, facts, words, numbers, images, and the like. It refers to unprocessed facts and figures without any added interpretation or analysis. As symbols, 'Data' is the storage of intrinsic meaning, a mere representation. The main purpose of data is to record activities or situations, to attempt to capture the true picture or real event. Therefore, all data are historical, unless used for illustration purposes, such as forecasting (Tuomi, 1999; Lang, 2001).

Information is data that has been collected, analysed and put into context. Information only becomes knowledge when meaning is given to it via interpretation. Information refers to data that has been interpreted so that it has relevant meaning, implication, or input for decision and/or action. Information comes from both current and historical sources. In essence, the purpose of information is to aid in making decisions and/or solving problems or realizing an opportunity (Tuomi, 1999).

Knowledge stems from information and data, as shown in the knowledge value chain (Figure 1). It is an individual's belief that is context-specific and it results from the individual's perspective and experiences (Handzic, 2003). Knowledge is the combination of information, experience and insights that may benefit an individual or an organization. The purpose of knowledge is to improve our lives and create value for any enterprise and all its stakeholders. In short, the ultimate purpose of knowledge is for value creation.

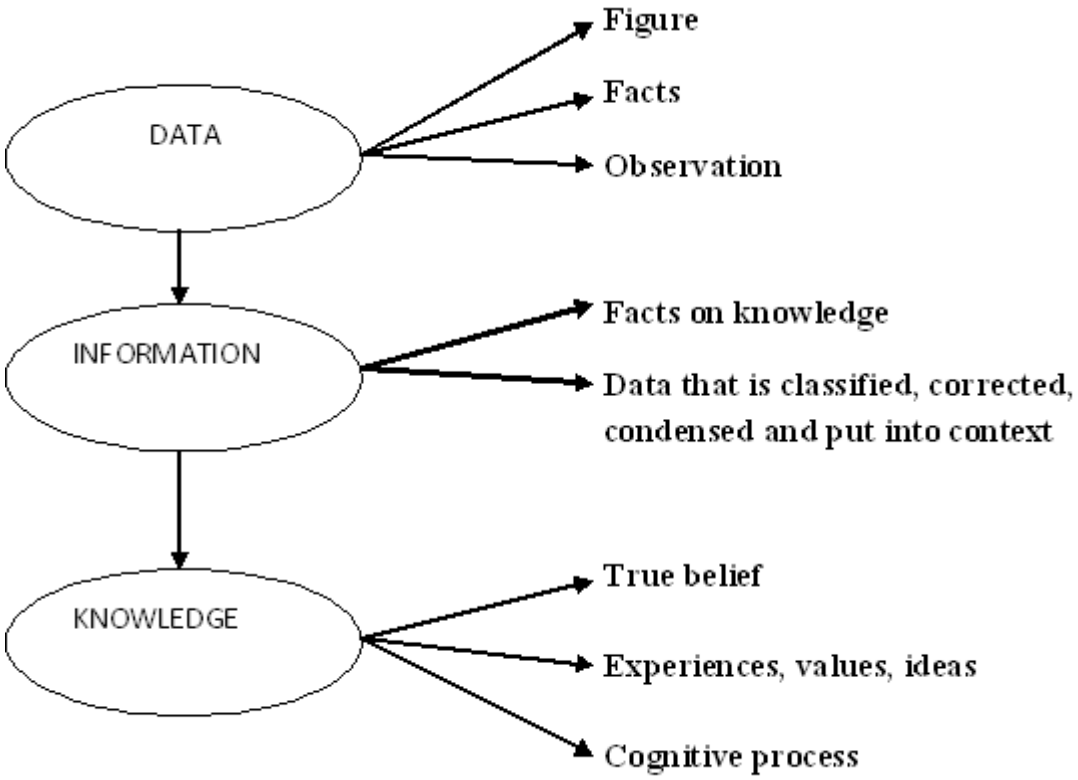

Figure 1: The knowledge value chain (Source: Ndoro, 2011)

Knowledge is subjective when it is based on an individual's perspective and experiences, but becomes more objective when individuals share their knowledge and experiences with others. The knowledge that has been shared will then influence the manner in which problems are tackled as well as the decision-making process. Communication, knowledge and information management are critical factors in any organization. They influence practical interactions affecting institutional goals and efficient service delivery. (Turner, 2003; Hastings, 1993; Salomon and Engel, 1997; Powel, 2003). Kunnumkal (2001) and Benyon (1997) concur that communication is connectivity of actions for the timely implementation of decisions to improve productivity. According to Okyere and Mekonnen (2012), almost every activity nowadays has become more ICT-reliant for one use or the other, and the benefits reach even those without first-hand access to it. We need knowledge and information for the development of agriculture so as to improve a lot of farmers, especially in the countryside of Africa (Salau, Saingbe, and Garba, 2013). Without farmers' exposure to agricultural information, agricultural transformation cannot be realized.

Unpacking ICT in agricultural extension

Unpacking ICT in agricultural extension cuts across three factors: Information; information communication; and communication technology. These are addressed briefly.

Information: This is data that has been processed in such a way as to be meaningful to the person who receives it. For productivity to improve, new information must be generated that will bring solutions to existing problems hindering maximum, profitable productivity. Research institutions, among others, are responsible for the creation of new information through practically investigating farmer's problems. The generated information must provide practical solutions to the existing farmer's productivity challenges. Ideally, for this new information to be relevant and accepted by the farmers, the farmers must be involved in the investigation process from its initial stages until the release of results. Smallholder farmers are, in most cases, side-lined during the process of information creation thus making them merely receivers of end results. This often results in the smallholder farmers not adopting such results because the results do not address the farmer's existing problems or fit his particular circumstances. This approach to creating information contributes to the low productivity of smallholder farmers. Approaches such as Agriculture Innovations Systems suggest that farmers who are part of the innovation process will end up with answers to their productivity challenges that are specifically suited to their farms, their capacity and their particular circumstances (Klerkx, et al, 2012).

Information Communication: This is the process through which information is transferred from a source to a receiver and back via a medium. "Effective knowledge and information management in the agricultural sector will be achieved when the right knowledge and information is delivered to the farmers and other stakeholders at the right time, in a user friendly and accessible manner" (UNDP ETHIOPIA, 2012: 32). Because information communication systems are often weak, while many research agencies, in the private and public sector continuously develop and release new technologies, not all these findings reach the intended farmers. More attention should be paid to effective two-way communication (Asopa and Beye, 1997).

Information communication has a direct bearing on farmers' decision-making, particularly with regards to agriculture. Information communication is a skill which is learnt and there are a number of factors that influences effective communication. For communication to be effective there has to be feedback that confirms understanding of what has been communicated (Dwumah et al, 2015). Most of the information in agriculture is generated and presented in the English language yet most of the smallholder farmers are illiterate. This makes it difficult for them to utilise such information for improved productivity. Large-scale farmers, on the other hand, have employees who can understand and put into practise any information presented in English [personal observation]. Failure to take account of the communication needs of smallholder farmers puts them at a disadvantage.

Communication Technology: This involves facilitating communication between two people. It involves the use of means of communication to transfer information such that the message reaches a large number of people within a shortest time possible. Communication technology includes devices (hardware) such as computers, radio, TV, telephone, cellular/mobile phones and faxes (Chhachhar, et al, 2014), as well as social media platforms such as specialised chat rooms, Facebook, Instagram and WhatsApp (Suchiradipta and Saravanan, 2016). It also includes software programs that are used to store, process and retrieve data.

Knowledge management in extension

Knowledge management can be defined as the condition of knowing a concept with a considerable degree of familiarity acquired through experience, association or contact (Seidman and McCauley, 2005). Knowledge management encompasses processes and practices concerned with the creation, acquisition, sharing and use of knowledge, skills and expertise. This then follows a circular non-stop process that continually updates itself (Bwalya, Okyere and Tefera, 2012).

For the circular flow of knowledge management to take place, knowledge that is sufficiently better than the existing knowledge and means for transmitting it must be both available. The consumers of the new knowledge must be willing and be able to use the better knowledge (Bwalya et al., 2012). The attainment of effective knowledge management in the agricultural sector requires the systematic and continuous interaction of stakeholders that include farmers, farmer organizations, research scientists, policy makers, extension agents

and the private sector among others (ASARECA, 2010). Therefore, to be effective, knowledge management in agriculture must embrace the following four issues, according to Bwalya et al. (2012), (i) comprehensive knowledge of what needs to be done to solve the sector's problems or to exploit its potential, (ii) identify how the problem could be solved or opportunities that could be exploited, (iii) the source of knowledge required for success, and (iv) determining who will be responsible for taking the actions needed to solve the problem or exploit the identified opportunities.

In order to obtain satisfactory results out of knowledge and information management, farmers need to be engaged in the whole knowledge management process. This is crucial as it will enable better integration of tacit and explicit knowledge. The knowledge and information created out of this process is also more likely to be accepted by the farmers as it would have incorporated knowledge and practices developed and passed on to them through generations. Such knowledge and information has a high potential of being implemented by these farmers in their daily farming activities hence improving their productivity. Farmers can also improve their existing indigenous knowledge not only through the interaction with modern knowledge but also by sharing experience with other farmers. However, in order to scale up knowledge to other farmers, the knowledge and information needs to be codified, made explicit, and upgraded or modernized with research based evidence (Bwalya et al., 2012).

Smallholder farmers in the developing world require up to date knowledge and information in order to be able to efficiently and effectively perform their farming practices. Bwalya et al. (2012) noted that the knowledge and information that farmers demand ranges from accessibility of new farming methods, availability of weather forecast, and supply of inputs and output prices among others.

ICT for the Dissemination of Agricultural Knowledge and Information

ICT can play a crucial role in benefiting the resource-strapped farmers with up to date knowledge and information on agricultural technologies, best practices, markets, price trends, and weather conditions. The experiences of most countries indicate that rapid development of ICT, which facilitates the flow of data and information, has tremendously enhanced the knowledge management practice in agriculture.

Knowledge is considered as the fourth factor of production after labour, land and capital (AFAAS, 2011) and is particularly critical in the agriculture sector. Making relevant knowledge accessible to the farming community helps improve production and brings higher returns. If the practice of smallholders is not supported by modern agricultural knowledge and information, agricultural households are likely to remain trapped in low productivity, food insecurity and poverty. Generating new agricultural knowledge and information and making it available for use by smallholder farmers through the extension service is important in promoting sustainable livelihoods and reducing rural poverty (Isaacs, 2007). ICT plays a very crucial role in enhancing information flow from its creation, storage, dissemination and usage by farmers. Figure 2 shows the flow of agricultural knowledge and information from creation to end use.

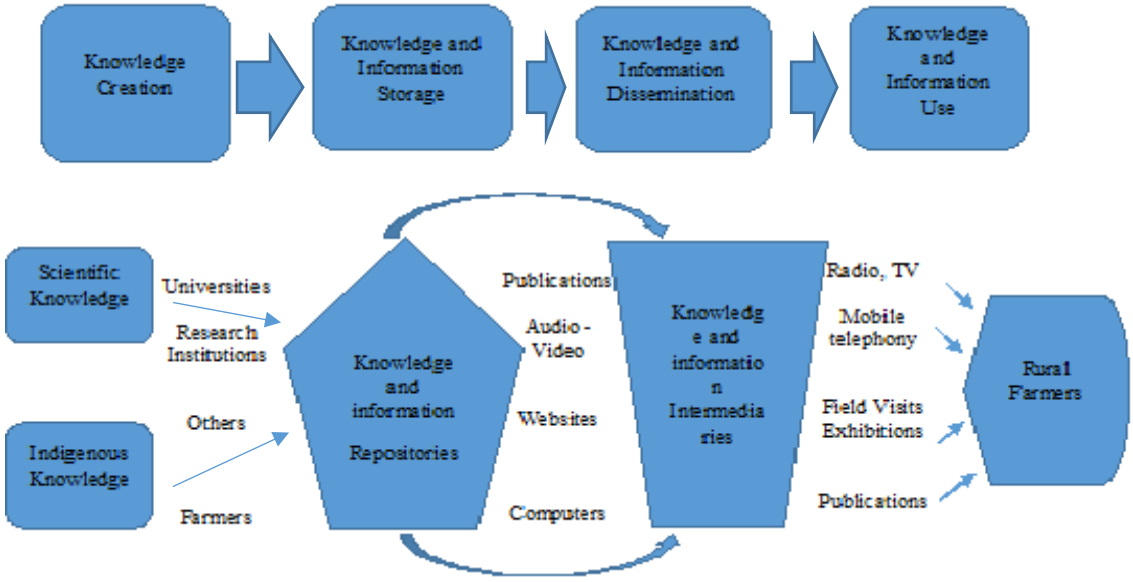

Figure 2: Tools of knowledge and information management in agriculture (Source: Bwalya et al., 2012)

Knowledge and Information creation - Various entities are engaged in the creation and development of knowledge and information. Likewise, several repositories and intermediaries play their role to bring the information and knowledge to the ultimate users. Agricultural knowledge and information is created from modern and indigenous sources. The modern knowledge and information is created through scientific research by universities and research institutions. Indigenous knowledge and information on the other hand refers to traditional knowledge, innovations and practices of local communities and is developed outside the formal education system (Bwalya et al., 2012).

Knowledge and information storage - Once it is created from these sources it is then stored in various forms before it is disseminated for use. Knowledge and Information creation requires the use of various ICT gadgets to enhance the collection and interpretation of data and these include but not limited to cell phones, video recorders, and internet for data collection as shown in figure 2. The creation of knowledge and information management by these institutes begins with identification of knowledge and information gaps, and the capturing, storage and dissemination of the knowledge and information to the users. This is conducted through a participatory approach involving stakeholders such as farmers, researchers, extension experts among others. The major sources for capturing knowledge and information are publications, conferences, events (field days, exhibitions, visits, etc.) and research reports. Whatever is obtained in this way is stored in various forms including publications, audio visuals, library services and websites among others.

Knowledge and Information retrieval - The stored knowledge and information is then disseminated to users such as rural farmers, through intermediaries notably during trainings, field visits, exhibitions, publications and using traditional forms of ICT (TV and radio), modern forms of ICT (Internet, mobile phones, etc.) and others. Effective knowledge and information management is achieved when the right knowledge and information is delivered to the right people at the right time in a user friendly and accessible manner that helps the recipients to perform their jobs efficiently (Islam, 2010). The outcome of effective knowledge and information management includes improved productivity and performance of the agricultural sector.

Knowledge and Information dissemination - The knowledge and information is then disseminated to researchers, extension experts, farmers and the public at large through publications, mass media (radio and television), internet, field days, exhibitions and interviews. In practice, however, field day's radio and TV programs were the major tools usually used to share knowledge and information to the smallholder farmers while internet and other modern ICT tools were seldom found to be used (Bwalya et al., 2012)

Knowledge and Information use – ICT can play a crucial role in benefitting the resource trapped smallholder farmers with up to date knowledge and information on agricultural technologies, best practices, markets, price trends and weather conditions. The experience of most countries indicates that rapid development of ICTs which facilitates the

flow of data and information, has tremendously enhanced the knowledge and information management practice in agriculture. For information to be accepted and used by farmers, it has to be timely, accurate, well understood and relevant to the farmer's problems. Extension service providers use ICTs to ensure that accurate knowledge and information is delivered on time and in a form that will be well understood by the farmers. The knowledge and information delivered to the farmer must also be relevant to the farmer's problems.

ICT challenges in agricultural extension

In Africa, this process of ensuring the effectiveness of knowledge management is limited by a range of constraints such as inadequate mechanism for capturing, systematizing and sharing available knowledge; inadequate analysis of agricultural sector communication stakeholders, their knowledge needs, attitudes and practices to knowledge management; use of less effective media and channels for communicating with different stakeholders; and weak monitoring and evaluation of knowledge management systems (ASARECA, 2010).

Various institutions and organizations in Swaziland are engaged in the creation, accumulation and dissemination of agricultural knowledge. Nevertheless, the use of ICT in knowledge and information management is so far not only low but also dominated by traditional ICT tools (radio and TV). The use of modern ICT (internet, mobile phones, etc.) in storing and disseminating knowledge and information remains very low, despite their huge potential. In this knowledge and information age, it is important to address the challenges that limit the use of such tools and identify the opportunities that should be tapped to assist smallholder farmers in their endeavour to improve production and match the standard of the large-scale producers.

ICTs that will educate smallholder farmers are very crucial because some of these farmers do not have control over the selling price of their produce. The only option they have is that of maximising their productivity at the lowest cost possible. Therefore it is imperative to harness the use of ICTs for the dissemination of all production knowledge and information especially to the smallholder farmers. However, while the use of ICTs seems relatively easy once in place, there are challenges associated with it.

Availability and affordability - Despite the fact that ICT has immense potential in disseminating agricultural knowledge and information, the low level of ICT infrastructure in

developing countries is believed to have hindered the sector from realizing its potential. This has inhibited the effectiveness of research institutions and extension agents from creating and delivering agricultural knowledge for use by rural farmers to increase productivity. In most cases extension agents and farmers are not connected to modern ICT infrastructure and services. As a result, research-extension-farmer linkages are weak and costly. Such a linkage ends up having to be fostered through physical contact such as training, field demonstrations, field day program visits.

In most cases, rural people live sparsely and this makes the provision of infrastructure and public utilities such as electric power, water, health facilities and some devices of modern ICTs very difficult to deploy in rural areas. The low level access to ICT infrastructure have slowed the sharing and exchange of knowledge and information generated from research centres at national and regional levels. Electricity infrastructure coverage in rural parts of developing countries remains low despite recent efforts to extend the electricity grid to rural areas through the rural electrification program. The low level of electricity coverage has in turn inhibited the expansion of ICT services to rural areas. (National Information and Communication Infrastructure policy, 2005). The incomes of rural people are very low compared to urban areas thus it becomes difficult for the rural people to afford modern ICTs. This then leads to a digital divide between urban and rural areas which then lead to rural areas remaining marginalised forever. (ITU, 2010; Gillward and Stock, 2008).

ICT operators on the other hand are not willing to invest in the rural areas due to low returns unless there are strong incentives to do so. This is mainly because of the high investment costs given the capacity of the rural people to pay for the services offered. Actually, the high cost of services is the very reason that continues to delay the uptake of many different forms of ICT in most of the African rural areas. Gillward and Stock, (2008) confirmed that the low income of the people in the African rural areas is the main adoption barrier of modern ICTs.

The other challenge is how to make ICT both affordable and available in venues that are convenient to smallholder farmers. Availability of venues refers to the presence of various access points particularly information kiosks, tele-centres, call centres, and so on in a manner that is accessible to the majority of the farmers. These services are not adequately available and accessible to the small farmer in developing countries.

Some of the African countries such as Ghana, Kenya, Nigeria and Senegal have a very dynamic telecommunications sector however Africa as a whole continues to lag behind other regions of the world in terms of its communication policies (Calandro et al., 2010). The national objective according to Calandro et al. (2010) of achieving universal and affordable access to the full range of communication services have been undermined either by poor policies constraining market entry and the competitive allocation of available resources; weak institutional arrangements with low technical capacity and competencies; and in some instances, regressive taxes on usage. Gilward et al. (2008) argues that in addition to competition and open access regimes, effective regulation of other factors such as spectrum, interconnection and tariffs are required to stimulate market growth, improve access, and lower prices.

Accessibility and usability - Gillward et al. (2008) discovered that diffusion of ICTs is highly uneven, concentrated in urban areas, and leaving some rural areas almost untouched. Income is the major barrier to the uptake of these technologies but as they become complex, they are increasingly constrained by literacy and education. The study also revealed that women are not equally able to access and use even the most prevalent forms of ICT. It was also reported that issues of income, education and social position played a role in explaining ICT access and usage. Statistics have indicated that a woman in a low income country is 21% less likely to own a mobile phone than a man. This scenario is disturbing for agricultural development in Africa where more women are involved in agriculture than men especially because they need technology and production information to improve their productivity.

The challenges of access to ICT can be divided into two: (i) access to ICT infrastructure and (ii) access to ICT services. The access to ICT infrastructure in developing countries is still very low. In spite of being a necessary condition, access to ICT infrastructure by itself is not sufficient for the dissemination of knowledge and information to occur through it. Access to ICT infrastructure must be accompanied by access to ICT services.

Awareness Culture and attitude - In addition to income, educational attainment, social and cultural constraints are other factors that affect the likelihood of an individual having the necessary e-skills to use different technologies optimally (Gillward et al., 2008). Munyua (2008) conducted a study on ICTs and smallholder agriculture in Africa and found low usage patterns and adoptions. The main challenges that influenced the use of ICT were summarised as: high costs of available technologies, inadequate infrastructure and low ICT skills, poor and expensive connectivity, Inappropriate ICT policies, language barrier, low bandwidth, inadequate credit facilities and systems. Moreover the author also identified inappropriate local content, weak institutions, inadequate collaboration and awareness of existing ICT facilities and resources, a poor sharing information culture as well as low awareness of the role of ICTs in development at all levels.

Conclusion

Smallholder farmers in the developing world require up to date knowledge and information in order to be able to perform their farming practices. The development of ICTs has facilitated the dissemination of knowledge and information and has revolutionized the use of technology in agricultural production for increased productivity. There is evidence that yield among rural smallholder farmers does improve with the use of ICT to access knowledge and information. However there are challenges in making ICT platforms available to a large number of the rural smallholder famers and these include availability and affordability of ICT infrastructure and it services. Accessibility and usability of such services is also a challenge among the smallholder farmers. Awareness, culture and attitudes of smallholder farmers towards the use of these ICT facilities are other factors hindering its adoption. For knowledge and information management to be effective, it must be timely delivered to the farmer in a user-friendly and accessible manner. Agricultural Extension is the ideal mechanism that can facilitate the introduction and subsequent adoption of ICTs for effective knowledge and information management especially among smallholder farmers.

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CHAPTER 4: AGRICULTURAL EXTENSION IN THE FACILITATION OF INFORMATION AND KNOWLEDGE ACCESS AMONG SMALLHOLDER SUGARCANE FARMERS THROUGH THE USE OF ICT

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Abstract

Information and communication technology (ICT) has witnessed substantial development and growth in Africa over the past decade. However, there is still a significant difference at the rate at which ICT penetrates the rural and urban areas with rural areas experiencing low rates. This has led to a challenge in information access among rural smallholder farmers, which contributes to poor rates of productivity improvement among this group of farmers. Drawing from relevant published works, this paper highlights that agricultural extension is particularly well positioned to address the problem of knowledge

and information access by smallholder farmers through the use of ICT. This paper discusses three key issues that influence information access: barriers to information access; knowledge and information management; and readiness of farmers for the introduction of ICT. It has been revealed that smallholder sugarcane farmers have a number of barriers that limit their access to information and the little knowledge and information that they possess is poorly managed due to a number of factors. Readiness towards the introduction of ICT was also found to be lacking however extension has emerged as a better option for improving knowledge and information access for this group of farmers. It is therefore suggested that farmers, with the help of extension officers must put in place an effective knowledge and information management system that will address barriers to information access and ensure that organisations and other stakeholders are ready for ICT to improve information access thus improving their productivity.

Key words: Extension, ICT, Agricultural information, Readiness, Barriers, Information Management, Smallholder Farmers.

Introduction

Agriculture provides livelihoods for 75% of the people who live in the rural areas of Africa, where there is a high prevalence of poverty and food insecurity. Low productivity in agriculture is a major contributor to this poverty and food insecurity among the majority of people living in rural areas of Africa. Therefore, there is a need to reduce the pandemic in this sector of society by improving agricultural productivity. Lack of access to information has been cited as the major reason for the low productivity in rural smallholder farmers in Africa yet it is crucial that new information must reach end-users very fast in order to use potential opportunities and achieve benefits (Milovanović, 2014; Newcomer & Caudle, 1991).

The introduction of ICT has improved the way in which information can be shared among individuals. It has provided better ways to share and integrate information. Information sharing within and between organisations has become an important factor in the effort to improve productivity in many organisations (Newcomer & Caudle 1991). Knowledge and information (separate from the communication technology involved) have been the major drivers of social and economic development in the world. They are collectively now regarded as another factor of production after land, labour and capital (Ethiopia, 2012). Comprehensive Information and accurate farming techniques are now leading factors of sustainable agricultural production. Farmers need to be cautious of the gains from the internet and other information and communication technologies so as to enhance their yields. Currently the benefits of ICT use in agriculture has not been fully exhausted yet it can enhance the ability of agriculture stakeholders to make informed decisions thereby improving agricultural output. (Kaaya, 1999; Phougat, 2006).

According to Christoplos and Kidd (2000), agricultural extension plays an important role in the development process of farmers through disseminating information, transferring technology, supporting learning, assisting farmers in problem solving and enabling farmers to become more actively involved in agricultural knowledge and information systems. With the mounting pressure of poverty and food insecurity, particularly in the context of climate change, extension is currently looking for better ways to support smallholder rural farmers in information, technology, guidance and empowerment. The improvement of ICT to agriculture should be assessed through cost reduction, increased effectiveness and improved productivity. (Christoplos & Kidd, 2000; Samah, Shaffril, Hassan, Hassan, & Ismail, 2009).

The use of ICT in agricultural extension is gaining momentum among farmers and their extension officers. Agricultural extension builds upon information exchange and this has been diagnosed as an area in which ICT can have a great impact (Masuki et al., 2010). It is widely acknowledged that extension officers, who are a crucial connector between farmers and other actors, in the dissemination of agricultural knowledge and information are well located to use ICT to access expert knowledge that will in turn be used to improve smallholder farmer's knowledge (Adebayo & Adesope, 2007; Omotayo & Adedoyin, 2005). Omotayo and Adedoyin (2005) further confirms that ICT use for extension can improve the effectiveness of extension workers as they play their roles in the empowerment of farmers, and can facilitate the flow of information in the application of agricultural extension among smallholder farmers in rural areas. This, however, is dependent on the readiness of both farmers and extension workers to embrace ICT and to integrate it into their information sharing processes.

One of the ways through which extension can reach a large number of farmers is to use ICT and that includes mobile telephony, cutting edge television and radio programmes, video shows, information kiosks, web portals, rural tele-centres, farmer call centres and video conferencing. The availability of ICT in agricultural extension will not only improve information access among farmers but will also make extension services more cost effective by enabling extension workers to reach more farmers than is currently possible without ICT. It will also reduce the costs associated with the way in which they disseminate information (Masuki et al., 2010). Timely dissemination of crucial information to different stakeholders for quality decision-making could also be facilitated with the use of ICT. The choice of ICT to use can also eliminate the challenge of illiteracy so often found among the rural smallholder famers, as information could be presented in formats and languages more readily understood by such farmers. Increasing the penetration of mobile phones in rural areas of Africa, for example, could facilitate the rapid dissemination of important messages from any given source to a specific target group of farmers in a language and format that can be easily understood by that group of farmers (Aina, 2006; Omotayo & Adedoyin, 2005). ICT is already being effectively used in rural areas of some African countries with substantial success in disseminating information on market prices, weather forecasts, transport information and general advice related to agriculture (Aina, 2006).

Given the established potential of ICT to substantially increase the productivity of the existing farming operations of smallholder farmers, it becomes essential to understand the prerequisites for and barriers to wide-scale application of ICT among currently disconnected remotely-situated smallholder farmers. Thus, this paper explores three key factors that influence the application and use of ICT by both extension workers and smallholder farmers to access the information needed to improve productivity: (1) barriers inhibiting the use of ICT (2) knowledge management among farmers and extension workers; and (3) Readiness of farmers and extension workers towards the use of ICT.

Methodology

Despite the involvement of many stakeholders in provision of agricultural knowledge to farmers, the level of access to agricultural knowledge among farmers in Swaziland is still low (Aina, 2006). Many factors have been identified by various authors to influence information access via ICT among sugarcane farmers. Uhegbu (2007) reported seven factors that affect information access among farmers, however, Ethiopia (2012) grouped these factors into three categories of (i) barriers to the use of ICT information management and (iii) readiness towards the use of ICT. These have been discussed by this article in accordance with the manner in which they influence information access between small and large scale sugarcane farmers.

A logical approach was implemented to identify the sources of material used for this research article. These materials included journal data base, library catalogue as well as other subject specific professional websites. Peer-reviewed journal articles were explored using online data base within the area of smallholder sugarcane farmers and ICT. Search engines such as google scholar were engaged to conduct more general searches which were also limited to smallholder farmers and ICT, published in English. Documents were checked to find out if they met the set criteria. None of the documents were left out due to their date of publication. After the abstracts were identified to be in line with the set criteria and worthy of further exploration, the whole article was then accessed. The articles were selected based on how they relate to the three key areas mentioned above which influences the application and use of ICT by smallholder farmers and extension officers. Articles deemed relevant were then included while additional sources of information were taken from internet websites.

Conceptual Framework

Figure 3 presents a framework to examine the differences in access to information as it is experienced by large-scale and smallholder sugarcane farmers. The framework is drawn from various literature which confirms the reality of a persistent productivity gap between smallholder farmers and large-scale farmers despite the substantial contribution of smallholder farmers to sugar production (Siyao, 2012). The productivity gap has been attributed to a number of factors, among which is poor access to information and knowledge among smallholder farmers – particularly those residing in remote rural areas. Numerous researchers have suggested a range of issues that influence access to information. As explained by Siyao (2018), these include:

- Societal, institutional, psychological and intellectual factors (Ellen, 2003);
- Physical barriers related to poor information and communication infrastructure (Ellen, 2003);
- The cost of information (Williamson, 1997);
- Level of education, with particular reference to literacy (Dutta, 2009);
- The paucity of communication tools such as computers and other ICTs (Norman & Ntokotha);
- The format and language in which information is made available (Aina, 2007);
- The number of extension workers (relative to the number of farmers) (Aina, 2006);
- Gender related issues (Materu-Behtsa, 2004); and
- Information facilities (Aina & Dulle, 1999).

In considering this list of issues influencing access to information, the framework presented in Figure 3 consolidates the issues into three broad categories: barriers; information management and readiness.

Barriers to information access: A number of barriers have been identified that limit information access by smallholder farmers, especially in developing countries. Mungania (2003) discovered that these barriers are heterogeneous and grouped them into seven types including: (1) personal or dispositional, (2) learning style, (3) instructional, (4) situational, (5) organisational, (6) content suitability and (7) technological barriers. Soekartawi (2005) observed that these hindrances towards the use of ICT to access information especially in

poor countries are generally related to infrastructure and Internet connection, personnel and government policies. Ali and Magalhaes (2008), on the other hand, divided barriers limiting use of ICT into two factors: organisational factors; and technical factors. Richardson (2005) suggested that ICT projects come with a lot of problems that include: over reliance on technology; inaccessible telecommunication infrastructure in a number of poor and isolated areas; capital costs of technologies; escalating costs of ongoing access and support; inherent need for capacity building; and lack of involvement of all stake holders in planning.

These findings suggest five types of barriers limiting farmers' access to agricultural information in developing countries: Information related barriers; Organisation related barriers; human resource related barriers; technology related barriers; and policy related barriers.

Knowledge and information management: This refers to the on-going process that leads to the identification and exploitation of current knowledge and opportunities and the creation of new knowledge and opportunities. The process in influenced by the source, the type, the timeliness, and the accuracy and timeliness of the information; and by the degree of requirement, the mode of communication, and storage of information.

Readiness: Readiness refers to being inwardly predisposed for some action. In this instance, readiness refers to the readiness of the farmers and of the extension workers to engage with information. It also refers to the availability of information infrastructure and to the management of information. In the cased of readiness for ICT, the readiness of farmers and extension workers to use ICT needs to be addressed before any technology is introduced (Kauffman & Kumar, 2005). This allows for proper planning so that efforts are focused in places where more attention is needed (Krull, 2003).

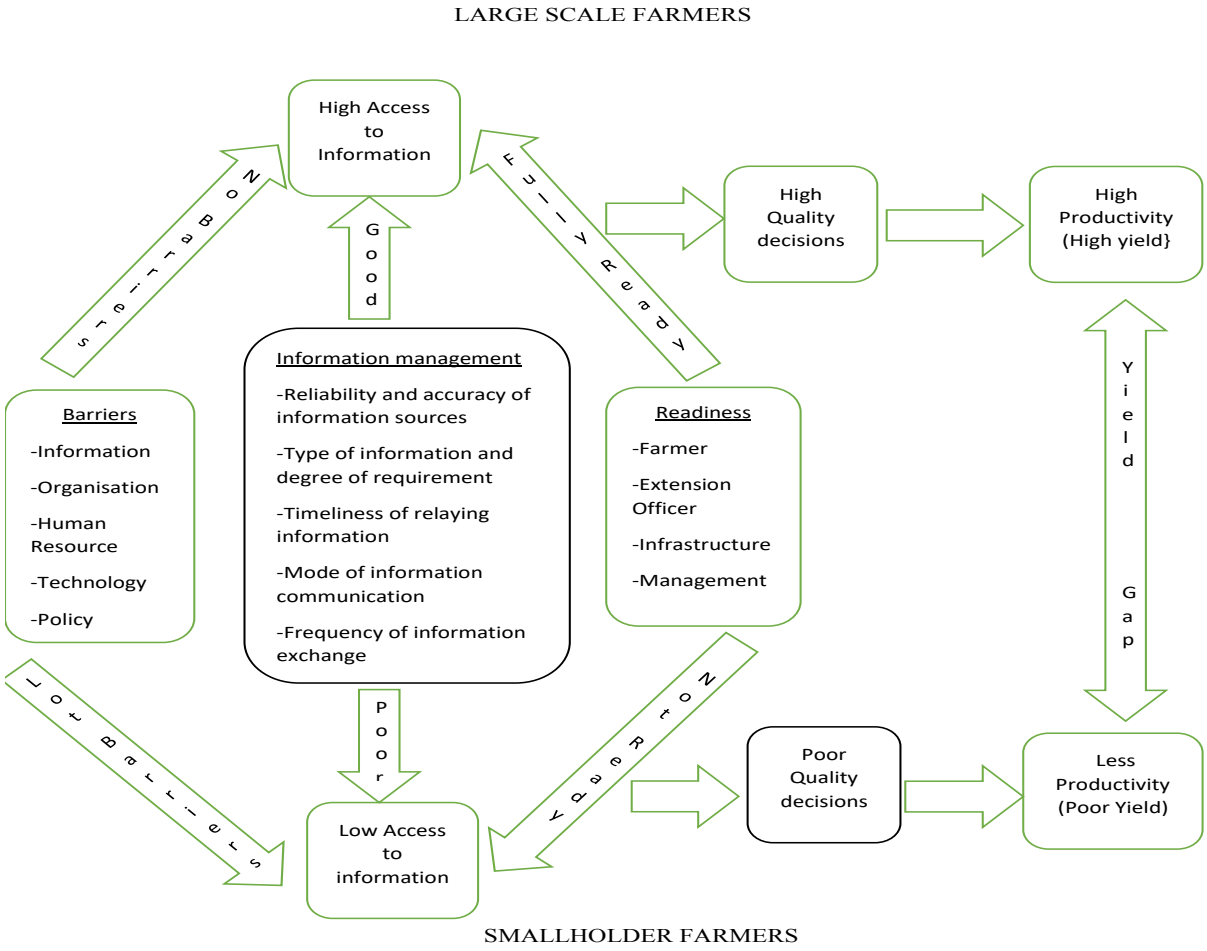

Figure 1: Diagrammatic representation of how information access influences the productivity gap between smallholder and large scale farmers.

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Previous studies have sought to study these variables in isolation of one another. However, the framework proposed in Figure 3, depicts an interdependency approach; that barriers to information access, information management, and readiness (e.g. among smallholder farmers and extension officers) are all linked to one another. Integrating these three factors to address the challenge of poor sugarcane productivity among smallholder famers so as to meet the increasing demand for sugarcane production is no easy task. The framework suggests that the use of ICT by agricultural extension could be a viable vehicle towards achieving improved productivity among smallholder sugarcane growers, thus narrowing the productivity gap that exist between smallholder and large scale farmers both locally and internationally – provided ICTs employed effectively address the issues related to barriers, information management and readiness.

Barriers to information access

Information related barriers – Information related barriers have two basic facets: access to information; and the nature of the information and its presentation. The levels of access to information are very significant in determining the levels of ICT usage by farmers (Barson et al., 2000). Farmers are unable to make full use of ICT to access information because in the rural areas, there is a limited number of information centres and sources within their reach. These include libraries where simple reading materials could be obtained (Dulle and Aina, 1999). Lack of practical demonstrations in field was identified by O'dell and Grayson (1998) as another barrier to information access for most farmers. In the event these information sources are available, they are either unreliable or outdated and are written or presented in English language thus making it difficult for farmers who are illiterate and/or do not speak English to understand.

Lack of information sources such as libraries within the farmer's vicinity as noted by Dulle and Aina (1999) is a major obstacle in accessing agricultural information. When smallholder farmers are expected to walk long distances so that they have access to information sources, it implies that even if a farmer may be aware of an existing information somewhere, it may be difficult to access it thus leaving the farmer uninformed.

Organisational related barriers - The majority of sugarcane farmers have organised themselves into farmer groups with a management structure in place. Organisational barriers emanate from attitudes of organisations towards information sharing. These organisational attitudes are shaped mainly by the management structure of the organisation and the group of people involved in the information sharing process. O'dell and Grayson (1998) found that information sharing becomes inconsistent when there is no clear management structure in that organisation. If the structure is not clear then it becomes difficult for farmers to understand the flow of information within the organisation. The exchange of information requires extreme changes in the behaviour of people in an organisation. Managerial practices and structural conflicts in an organisation have been identified as the major cause of organisational barriers to information sharing. Any delays in addressing these barriers can result to a downward trend in production by the organisation (O'dell & Grayson, 1998)

Gil-Garcia, Chengalur-Smith, and Duchessi (2007) argued that the standard of information exchange increases as information sharing moves from an intra-organisational

level into an inter-organisational level. The complexity is such that information sharing among related organisations is often compromised. Some organisations fear losing their competitiveness if they share technical information with other organisations. Sometimes smallholder farmer organisations feel that information sharing is only for large scale farmers and that it is an extra financial load that will contribute very little to the productivity of their organisation (Barson et al., 2000).

(Barson et al., 2000) also observed that smallholder farmer groups with centralisation in hierarchical structures have adverse effects on the exchange of information. The drive among farmers to share information is compromised if they do not enjoy freedom as a result of limited autonomy, or they are compelled to request for permission from their seniors to implement decisions.

Farmer groups that have a high level of bureaucracy and strict administrative control have a very low information sharing spirit (Bureš, 2003; Willem & Buelens, 2007). Further, formal laws, guidelines, procedures and regulations may become hindrances to information sharing, whereas less formalized organisational structures with voluntary information exchange may result to open interaction within farmers thus creating a beneficial environment for information dissemination (Willem & Buelens, 2007). Senior management has been identified to play a crucial role in the adoption and implementation of information sharing systems and any innovation in information sharing system in an organisation cannot be adopted if there is no support from top management (Caudle, Gorr, & Newcomer, 1991).

Inadequate numbers of agricultural extension agents is a further hindrance to information exposure among farmers. Low Agricultural Extension Officers-to-farmer ratios impedes farmers getting new information due to reduced frequency of visits (Aina, 2006; Isinika & Mdoe, 2001). Mntambo (2007) observed that there is minimum information flow regarding the latest agricultural technologies in areas where there is a limited number of extension agents.

Human resource related barriers - Human resource barriers are barriers emanating from behaviours and actions of people within or between farmer groups. Information in a group of farmers is often scattered among individuals, and the information that other members may need, may be held by others within the group. Constant, Kiesler, and Sproull (1994) noted that the efforts of organisations to invest in sophisticated information technology could be useless if the farmers in that farmer group are not prepared to share their

information. Individuals can only share information if they are pleased. Unsatisfied or aggrieved individuals usually will not want to share information. Similarly, Cress, Kimmerle, and Hesse (2006) found that many farmers are not willing to share and contribute their knowledge with other farmers, indicating that one of the main hindrances towards sharing information is lack of encouragement particularly when individuals feel that they will lose the power that comes from ownership of crucial information when they share it. It is, therefore, very important for extension workers to explore farmer's attitudes in a farmer group and to develop means by which these attitudes could be improved.

Gender also impacts access to information. Woman often have a high workload which sometimes prevents them from attending meetings and workshops where vital information is being shared. Ozawa (1995) observed that the dual domestic and production roles played by woman in the rural set up often leaves them very tired to even listen to the radio; it also makes them to be reluctant towards partaking in extension activities. Whitley (1997) reported that most rural African families would prefer sending a male child to school than sending a female child; this leaves the female child disadvantaged when she later becomes an adult in need of information. Omotayo and Adedoyin (2005) noted that even though there is an increase in the awareness to reach woman farmers, agricultural extension activities are still focused towards male farmers. Similarly, Aina (2006) found that, in most cases, extension agents focus their extension services on male farmers and hardly reach out to female farmers even though they make a good portion of smallholder farmers in Africa.

The failure of farmers to obtain needed information from appropriate and credible sources is another barrier to information accessibility. When farmers are not confident about the information they possess, they feel reluctant to share such information. Williamson (1997) and Dutta (2009) associated this lack of confidence to lack of education. In particular, illiteracy is a major barrier to information access and most smallholder farmers in Africa are illiterate thus they cannot use modern ICT as a as a means for distributing agricultural information (Aina, 2006; Carter, 1999; Mbozi, 2002). Dutta (2009) observed that due to the illiteracy of farmers, they often obtain information that is old, unreliable and inaccurate via informal networks and this affects their knowledge and eventually their productivity.

Technology related barriers - Complexity is one factor that also influences the adoption of information exchange. Different organisations may use different technologies to share information. However, the challenge is integrating them (Newcomer & Caudle, 1991).

Premkumar and Ramamurthy (1995) observed that a less complex technology is easier to adopt, and that attributes like functionality, reliability and accessibility causes farmers to effectively use the technology for information exchange. Poor ICT infrastructure is viewed by Dawes (1996) as a barrier to information sharing, and this could be associated to the unavailability, lack of awareness and commitment from senior management about the use of ICT tools to disseminate information. Poor conviction in ICT tools, phobia of information systems breakdown and poor capabilities towards operating technology tools also constitute barriers to information sharing. Connected to this is lack of ability to keep up with the ever-changing technology in terms of use and maintenance of the technology (Dawes, 1996).

Physical barriers to information accessibility are comprised primarily of poor communication facilities (Ellen, 2000; Masuki et al., 2010) which infrastructure is an indispensable prerequisite for widespread socio-economic development of a society (Cogburn & Adeya, 2000). In most African countries, however, communication infrastructures are weak resulting in low internet usage, low telephone penetration, limited broadcasting facilities, inadequate computing infrastructure and other consumer usage (Cogburn & Adeya, 2000). Some information systems have specific challenges. Television and radio, for example, are ideal sources of information, but they are expensive and cannot be operated without electricity mains or batteries, both of which are very scarce and/or costly in rural areas (Dutta, 2009; Lee Eden & Kalusopa, 2005).

Policy related barriers - Most African countries continue to remain behind other countries of the world regarding the introduction of ICT, especially in the rural areas. Achieving a universal and affordable access to a complete range of communication services is affected by poor policies hindering market entry (Calandro & Moyo, 2010). Milovanović (2014) noted that suppliers of ICT and policy makers are not sure about the capacity and eagerness of the rural people to adopt and use ICT. Consequently there are small numbers of programs that are aimed at improving the implementation and use of ICT within the agricultural sector of isolated areas.

Policies for communication in rural areas must put the rural people in a position where they will have exposure to information related to their livelihoods. These policies must assist the rural people to develop skills and knowledge on how to use and benefit from the information. Policies are implemented to set the rules, direction and frame for the improvement of rural communication. An enabling communication policy environment

allows for a free flow of information amongst different stakeholders in a society (Calandro & Moyo, 2010; Milovanović, 2014).

Rural communities where most smallholder farmers are located need this special attention because their communication infrastructure is usually less developed than that of their urban counterparts. Due to lack of infrastructure, communication services in rural areas are commercially less attractive and this makes farmers less aware of economic possibilities and other opportunities. ICT must be available, accessible, demand driven and affordable to the majority of rural smallholder farmers. Policies and investment strategies need to be identified and recommended in developing countries to help smallholder farmers benefit from ICT based agricultural knowledge and information management (Ethiopia, 2012).

The main challenge with national communication policies is that they are out-dated, over-regulated and/or uncoordinated. In most cases, these policies neglect the special needs for rural people. Further, poor implementation of existing policies makes policies to be ineffective. Corruption and dishonest activities regarding regulations can also be a problem in development of media strategies. Remote and poor areas are in most cases not commercially attractive for investment in services and infrastructure. Investors also need concrete incentives in order to invest in a given area. (Calandro & Moyo, 2010).

Readiness

The use of ICT is expanding more widely to different sectors including agriculture. Amongst the many ICT applications, e-learning has become one of the most commonly used applications whereby available technologies are used to enhance learning among farmers and facilitate information access in the agricultural sector.

The readiness of farmers and extension workers to use ICT in any community is an issue that needs to be addressed before that technology is introduced (Kauffman & Kumar, 2005). The assessment of ICT readiness allows for proper planning for its integration so that efforts are focused in places where more attention is needed (Krull, 2003).

Readiness is defined by So and Swatman (2006) as being inwardly predisposed for some action. Trinidad (2002) emphasised that it is very crucial to conduct an initial assessment of preparedness for e-learning among farmers and extension workers before a new technology is introduced. He explained further that assessing preparedness should

consider the availability, accessibility and affordability of the communication hard wares to farmers which include computers, Internet, mobile and fixed phones. Watkins (2003) proposed that the assessment for e-learning readiness among farmers should also include the ability to operate these gadgets.

Even though ICT has a huge opportunity for distributing information among sugarcane farmers, the unavailability of ICT infrastructure in the most remote areas is believed to stop this sector from achieving its potential. According to Darab and Montazer (2011), the evaluation of infrastructure readiness must focus in assessing whether the current infrastructure has the ability to sustain the new intervention and if not, it must be upgraded or additional infrastructure provided.

Some of the main challenges that hinders the delivery of agricultural extension services is inadequate infrastructure and poor financial base. Most smallholder rural farmers have no connection to electricity and are without electronic equipment that they need to effectively receive and disseminate reliable information on time amongst themselves (Davis et al., 2010). The SSA through its technical service and extension department is the only vibrant link that currently connects research output with the sugarcane growers in Swaziland, however there is still a weak link between the other extension service providers and research institutions. Davis et al. (2010) noted that these links must be developed so that they are used as means for generating, disseminating and improving agricultural knowledge and activities of smallholder farmers. The availability and accessibility of ICT by these stakeholders can help improve this linkage thus improving farmer's access to accurate, reliable and timely information for improved productivity.

Some of the factors that have shown to have an influence on ICT acceptance include age, gender, ethnicity, marital status, level of education, experience with computers and internet, thus they too need to be assessed in order to determine readiness towards the introduction of ICT among smallholder farmers (Durndell & Thomson, 1997; Muilenburg & Berge, 2005; Ong & Lai, 2006; Teo & Lim, 2000; Whitley, 1997).

Readiness also depends on the presence of a knowledgeable ICT specialist for training purposes. ICT training should be included in the education curriculum of schools from primary to tertiary level with some short courses tailor made for those already in the field. Human resource readiness, on the other hand, focuses on evaluating both providers and

users in terms of motivation, attitudes, and skills needed in implementing e-learning (Ethiopia, 2012). Machado (2007) suggested that before the implementation of e-learning services, it is crucial to apprehend management's vision, their skills in implementing policies and the strategies that support e-learning. Machado further argues that policies and strategies help in building capacity of stakeholders in terms of motivation and training.

Information management

Information management is relevant to all job functions and processes of farming, as it captures the learning and sharing of best practises that benefit both smallholder farmers and extension officers. An effective system of information management identifies clearly the type of information needed and its reliable and credible sources. It also establishes the degree of requirement and the communication mode, the storage, accuracy and reliability of information (Quintas et al., 1997).

Reliability and accuracy of information sources - Kok (2007) noted that the competitive edge of a sugarcane grower is often a result of good knowledge management encompassing what he knows, how he uses what he knows and how fast he learns. Carneiro (2000) added that the ability of a farmer to respond quickly to new innovations was also very important, as it has a great influence in the success of information management. It is therefore very important for farmers to have unlimited access to reliable and accurate information sources.

Smallholder farmers are limited by a variety of constraints, many of which are caused by lack of reliable and accurate information to make good decisions. Increasing the value of ICT resources available to farmers is crucial in making smallholder agriculture highly productive. The correct placement and utilisation of ICT is central to this improvement and the basic function of extension as explained by Christoplos (2010) remains that of transferring and exchanging of practical information for the farmer to improve his outcomes. McNamara (2009) noted that smallholder farmers encounter higher information costs, due to their isolation as well as the poor state of their ICT infrastructure. To realise benefits of reliable and accurate information, it is essential that farmers and extension officers put in place a knowledge management system that relates to the nature of their work and what they intend to produce (Ndoro, 2011).

Type and degree of information requirement – Burton-Jones and Hubona (2006) argued that the challenge with most underdeveloped communities is that the farmers are not aware of what type of information they need. They further do not know what information is at their disposal to help them solve their challenges. The strengthening of linkages by extension among the sugar industry players enables the free flow of vital information for improved productivity especially among the disadvantaged smallholder sugarcane farmers.

Quintas, Lefrere, and Jones (1997) and Kiessling, Richey, Meng, and Dabic (2009) defined knowledge management as an on-going process that leads to the identification and exploitation of current knowledge and opportunities and the creation of new knowledge and opportunities. It enables farmers and extension officers to expand how they develop, accept, validate, diffuse, store and utilise knowledge so as to reach their objectives quicker and successfully.

Timeliness of relaying information - Timely dissemination of critical information to different stakeholders for quality decision-making is very important and this could be facilitated through the use of ICT. According to Meyer et al. (2011) information is one of the most valuable resources for improving productivity among smallholder sugarcane farmers and extension is ideally positioned to facilitate its free flow within all the sugar industry stake holders. Correct and timely information can help smallholder sugarcane farmers to make quality decisions and take appropriate action. To facilitate development and hence improve productivity, important information needs to be made available on time and made accessible through the use of ICT particularly to the smallholder sugarcane growers (Meyer et al, 2011).

The creation of new knowledge must be an on-going process that will ensure knowledge is spread extensively and at the right time to the majority of smallholder sugarcane growers (Kiessling et al., 2009; Liao, 2003; Nonaka & Konno, 1998). Relaying information on time is very crucial because it can be used by different stakeholders to achieve success through competitiveness, innovativeness, and responsiveness (Alavi & Leidner, 2001; Gao et al., 2002; Liao, 2003; Marouf, 2004; Nonaka & Konno, 1998; Quintas & Ray, 2002; Zheng, 2009)

Mode of information communication - The availability of communication infrastructure, especially in the rural areas where most of the smallholder growers are located should be a priority for the government if productivity is to be improved. One of the ways through which extension can reach a large number of farmers is to use ICT and that includes mobile telephony, cutting edge television and radio programs, video shows, information kiosks, web portals, rural tele-centers, farmer call centers and video conferencing. It will also reduce the costs associated with the way in which they disseminate information (Masuki et al., 2010).

Frequency of information exchange - The introduction of ICT has improved the way in which information can be shared among individuals. It has provided better ways to share and integrate information. Information sharing within and between organizations has become an important factor in the effort to improve productivity in many organizations (Newcomer & Caudle 1991). Agricultural extension builds upon information exchange and this has been diagnosed as an area in which ICT can have a great impact (Masuki et al., 2010). It is widely acknowledged that extension officers, who are a crucial connectors between farmers and other actors, in the dissemination of agricultural knowledge and information are well located to use ICT to access expert knowledge that will in turn be used to improve smallholder farmer's knowledge (Adebayo & Adesope, 2007; Omotayo & Adedoyin, 2005)

Summary

This paper has highlighted that smallholder sugarcane farmers lack an effective system for managing Information and knowledge using ICT and this makes them to have poor access to information. They end up getting information that is less accurate, out-dated and less reliable resulting to poor farming decisions that produce poor yields. Barriers towards the use of ICT have also come out to be very strong among the smallholder farmers and this propels smallholder farmers to make poor decisions in their farming process resulting to poor yields. Most of these barriers are organisation related, human resource related, technology related and policy related. Regarding readiness of smallholder farmers towards the introduction of ICT to facilitate information access, this paper has shown that smallholder farmers are not ready mainly because of poor communication infrastructure, poor management and a high illiteracy rate among themselves.

Agricultural extension has been presented as the ideal mechanism through which smallholder farmers could be assisted in their quest to access expert knowledge that will in turn be used to improve their productivity. Extension can achieve this through teaching farmers on how to manage information using available and cost effective ICT as well as addressing those barriers that limit information access. Extension services can also coordinate with government the introduction of the necessary infrastructure as well as prepare smallholder famers for the introduction and use of ICT through training programs for the farmers.

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CHAPTER 5: BARRIERS TO SUGARCANE PRODUCTION INFORMATION ACCESS VIA ICT: PERCEPTIONS OF EXTENSION OFFICERS AND SMALLHOLDER SUGARCANE GROWERS IN SWAZILAND

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Abstract

This paper aims at investigating barriers to sugarcane production information access via ICT among the Swaziland sugar industry stakeholders as perceived by extension officers and smallholder sugarcane farmers. The study was a census involving all active smallholder sugarcane farmers (N=172) in Swaziland and their extension officers (N=17). Quantitative data were collected through face-to-face interviews using a valid and reliable structured questionnaire. Descriptive statistics and one way analysis of variance (ANOVA) were applied to analyse the data using SPSS version 20 statistical software. The results of the study revealed that sugarcane farmers do not perceive any of the barriers to be a hindrance to information access via ICT. However, extension officers differed regarding some of these barriers. The study also revealed that gender, educational level and respondents' job category

have a significant influence on the perceptions of the respondents. Therefore, these demographic variables must be considered when planning the introduction of ICTs to enhance information access within the sugar industry stakeholders. The results of this study could provide guidance to the government or relevant organisation when considering barriers that may hinder the use of ICTs for information access.

Key words: Extension, ICT, Sugarcane, Barriers, Smallholder farmers, Swaziland**.**

Introduction

Agriculture is the mainstay of Swaziland's economy and it also underpins the landlocked country's development endeavour. It is a sector with great potential for stimulating growth and employment, consequently eradicating poverty. One of the main crops grown in the country is sugarcane which is also Swaziland's largest industry. The country is the fourth biggest manufacturer of sugar in Africa (following South Africa, Egypt and Sudan). About 60% of the country's agricultural output comes from sugar manufacturing, and it adds about 18% to Swaziland's Gross Domestic Product (GDP). About 35% of the of the country's wage employment comes from the sugar industry. The industry is made of four components including, large millers and estates (77% of production); large-scale farmers (17% of production), medium-scale farmers (5% of production) and smallholder farmers (1% of production). Though accounting for a smaller volume of overall sugarcane production, the largest number of farmers come from this category of small- and medium-scale farmers (Esterhuizen, 2013).

The sugar industry sector in the country has evolved tremendously in the past ten years. However, when the productivity of smallholder sugarcane farmers versus large scale sugarcane farmers is analysed, there is a consistent average difference of ten tonnes cane per hector with smallholder growers on the lower side (Dlamini & Dlamini, 2012). There is, therefore, huge room for improvement by smallholder sugarcane farmers in order to meet the performance of their large-scale counterparts. Among many factors that could have contributed to this gap, is insufficient knowledge through which smallholder farmers could access information. Poor access to information leads to farmers making poor farming decisions that have a negative effect on yield. Different studies have raised a number of issues that are a hindrance to the accessibility and adoption of sugarcane information. Ochieng (1999) cited high illiteracy rate among smallholder sugarcane farmers as a hindrance. Demographic and background characteristics have been found by numerous studies to have an influence towards the accessibility and adoption of sugarcane production information by smallholder farmers (Muilenburg & Berge, 2005; Ong & Lai, 2006; Whitley, 1997).

Information is regarded by many writers as another important factor of production and a key factor that has an impact on the progress of a society and it also contributes to the improvement of a nation's economy. Information connects the world, dramatically changing

our lifestyles and it provides a platform for underdeveloped nations to establish strategies for competing with their developed counterparts (Majid & Kassim, 2000; Zahedi & Zahedi, 2012). Olorunda and Oyelude (2003) regard information as a strategic resource, a foundation and a commodity for every operation in an organisation. Information helps producers to become more focused and to be able to analyse issues more clearly, thus making precise decisions (Ikoja-Odongo & Ocholla, 2004). The role played by information towards agricultural development is very crucial and it is regarded as a basis for extension service delivery (Ofuoku, Emah, Itedjere, & BE, 2008). An increase in the flow of accurate and relevant information in an organisation leads to improved agricultural development (Lee Eden & Kalusopa, 2005; Manda, 2002).

Purpose

The main reason for this article was to investigate the barriers towards the use of ICTs in accessing sugarcane production information as perceived by smallholder sugarcane farmers and their extension officers. The research was guided by the following objectives:

1. Describe respondents by demographic variables;
2. Determine the barriers that prevent the use of ICTs to access sugarcane production information as perceived by sugarcane farmers and their extension officers[1]; and
3. Explain if demographic variables of respondents (age, gender, education, experience, marital status and respondent's category) do affect their perceptions.

Significance of the study

The identification of barriers to sugarcane production information access via ICT will assist in designing a better information system that will enable smallholder farmers to meet their information needs in Swaziland. Furthermore, the results will encourage smallholder farmers to adopt appropriate means of seeking accurate and up-to-date sugarcane production information on time, thus improving their productivity.

[1] The data presented was interpreted in the context that all of the respondents owned or had access to cell phones. This was established in the part of the study addressing readiness towards ICT introduction (see Chapter 6).

Methodology

The research was carried in the year 2015, within the Lowveld region of Swaziland, where sugarcane is predominantly grown. The methodology used was a survey using the interview technique. This study employed quantitative research to investigate perceptions of sugarcane farmers and extension officers regarding barriers that hinder sugarcane farmers from accessing sugarcane production information via ICT. Four enumerators who had recently graduated from the University of Swaziland were hired and trained on how to collect the data. The study was a census and a structured questionnaire was used to interview all the smallholder sugarcane farmers (N=172), as well as all the sugarcane extension Officers (N=17) actively growing sugarcane in Swaziland during the year of data collection.

Data were collected with a pre-tested schedule. Descriptive statistics and ANOVA were applied to analyse the data using SPSS 20. The study aimed at determining any significant deviation in the perceptions of respondents regarding the barriers based on the background and demographic variables. A series of one-way analysis of variance (ANOVA) were performed to observe if the responses of the participants differed according to age, gender, education level, experience, marital status and respondent's category. Five factors were investigated, including information-related barriers, organisational-related barriers, personnel-related barriers, technology-related barriers and policy-related barriers. For testing significant differences, the alpha level was set at 95% ($P < .05$). Frame-error, selection-error and non-response error were managed in line with suggestions by Miller and Smith (1983). An updated list of all current and active smallholder sugarcane farmers was obtained from the Swaziland Sugar Association (SSA) extension services, thereby managing frame-error. Farmers who appeared on the list yet were no longer growing sugarcane were removed to control selection error. A group of experts consisting of two extension managers from SSA, one extension manager from FAO (Swaziland) and four academic staff members from the University of Swaziland, Department of Agricultural Education and Extension were requested to check the instrument for content validity. The content validity of the instrument was approved by the experts. To determine the reliability of the instrument, a pilot test was conducted involving smallholder sugarcane growers from Vuvulane Sugar Estates who did not participate in the study. To compute the reliability coefficients of independent variables, the study employed Kuder Richardson (KR21) and Cronbach Alpha procedures.

Instrument

The instrument was presented into two parts: Part I listed variables related to demographic characteristics and background information. Respondents were requested to make their choices as per each item. Part II consisted of items pertaining to barriers towards the use of ICT to access sugarcane production information. Respondents had to rate each item using a Likert type scale ranging from one (strongly disagree) to six (strongly agree). A cut-off point of 3.5 was established such that all those responses with a mean value of 3.5 and less were categorised as having disagreed and all those above 3.5 were recorded as agreed.

Theoretical framework for the study

Extension exists to make agricultural information accessible to farmers and other stakeholders who need it to improve productivity (Salau, Saingbe, & Garba, 2013). Unfortunately, extension currently does not meet this goal. The public extension service, especially in the Sub-Saharan Africa region, has not been effective enough in conveying agricultural information to farmers. Farmers sometimes resist a much-needed improved technique not because they do not want it but because they are ignorant of the practice (Salau et al., 2013).

Masuki et al. (2010) argues that agricultural information plays an important role in the development of smallholder farmers towards increased production. He noted that most smallholder farmers are located in the rural areas, therefore an increase in their production automatically leads to a more desirable lifestyles for the rural people, food security and national economies of the countries where they operate. When reliable and accurate information is availed on time to smallholder farmers, they can reduce their production costs, improve their productivity, have collective bargaining with buyers and input suppliers, thus maximising their profit margins (Ikoja-Odongo & Ocholla, 2004; Masuki et al., 2010; Richardson, 1997).

As discussed in (Dlamini & Worth, 2018) [Chapter 4], a conceptual framework was developed to demonstrates the differences between smallholder farmers and large-scale famers with regard to accessing information via ICT – highlighting the influence of barriers, information management and preparedness for ICT introduction.

Briefly, the principal barriers to accessing information are: Information-related barriers; organisational-related barriers; human resource-related barriers; technology-related barriers; and policy-related barriers. Barriers related to the information itself include issues such as the format, language and content of the information. Barriers related to organisational issues encompass the dynamics, practices and behaviours underpinning information gathering and sharing within and among organisations. Human resource-related barriers, similar to organisational barriers, arise from the dynamics, practices and behaviours surrounding information exchange between and among individuals and groups of individuals (Dlamini & Worth, 2018) [Chapter 4].

Technology-related barriers broadly encompass issues related to the complexity of information sharing systems and mechanisms. They also include issues of practical, physical access and the presence (or lack) of communications infrastructure. Policy-related barriers refers to government regulations and policies addressing communications infrastructure, gathering and analysing information, and disseminating information (Dlamini & Worth, 2018) [Chapter 4].

As shown in Figure 1, barriers limiting access to information by smallholder rural farmers, are substantial. This fosters poor decision-making about the production and other operations of their farming enterprises which then leads to lower than possible yields. Conversely, Figure 1 also shows how, for larger-scale farmers, there are few or no barriers. It is proposed that most of these inhibiting elements relate to lack of information, organisational capacity, human capacity, practical access to ICT infrastructure, technology, and to public policy.

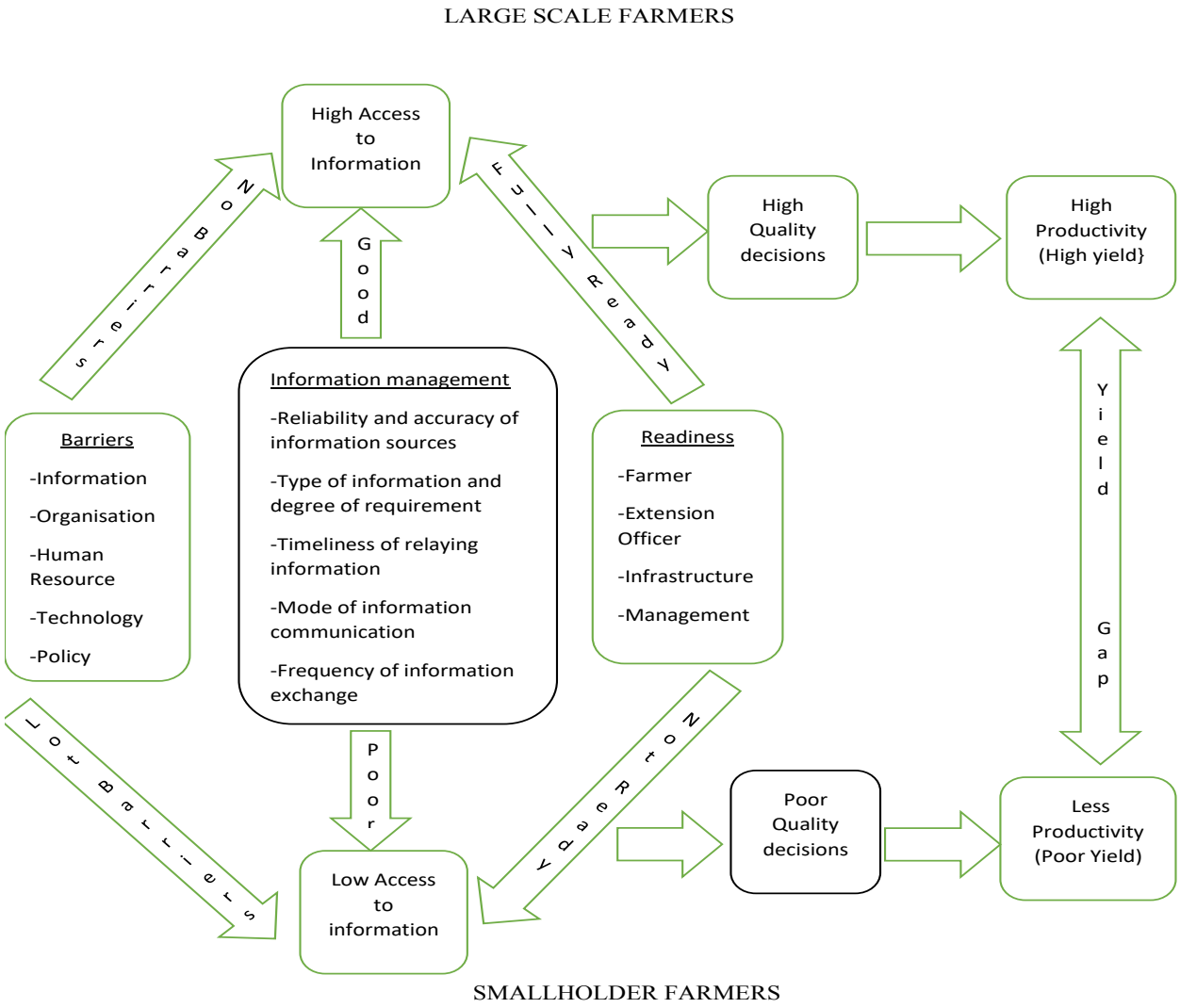

Figure 1: Diagrammatic representation of how information access influences the productivity gap between smallholder and large scale farmers.

Results and discussion

The reporting of results and discussions are organised into three sections. The first section responds to the first objective of describing the demographic variables of respondents. The reliability of the survey instrument is also discussed in this section. The second section reports results for the second research objective of determining the barriers that prevent the use of ICTs to access sugarcane production information as perceived by sugarcane farmers and their Extension Officers. The third section describe results for the third research objective explaining if demographic variables of respondents (age, gender, education, experience, marital status and respondent's category) do affect their perception of barriers towards sugarcane production information access via ICT.

Respondents Demographic Variables

To present a good understanding of the respondents, research objective one aimed at describing respondents according to their demographic variables, including age, gender, education level, sugarcane production experience and marital status. Results are presented in Table 1 below and they reflect that the most of the respondents were in the age group of 30 – 39 years (38.6%) followed by those in the range of 40 -49 years (19%) age group for both smallholder farmers and extension officers.

Table 1: Respondents' demographic profile

		Farmer (N=172)		EOs (N=17)		Total (N=189)	
Characteristic	Category	F	%	F	%	F	%
Age	19 - 29	24	13.9	3	17.6	27	14.3
	30 - 39	64	37.2	9	53.0	73	38.6
	40 - 49	32	18.6	4	23.5	36	19.0
	50- 59	25	14.5	1	5.9	26	13.8
	> 60	27	15.8	0	0	27	14.3
Gender	Males	124	72.1	17	100	141	74.6
	Females	48	27.9	0	0	48	25.4
Education	None	8	4.7	0	0	8	4.2
	Primary	30	17.4	0	0	30	15.9
	Secondary	38	22.1	0	0	38	20.1
	High school	56	32.6	0	0	56	29.6
	Tertiary	40	23.3	17	100	57	30.2
Experience	1 – 5	69	40.1	4	23.5	73	38.6
	6 – 10	28	16.3	7	41.2	35	18.5
	11 – 15	40	23.3	3	17.6	43	22.8
	16 – 20	14	8.1	2	11.8	16	8.5
	21 <	21	12.2	1	5.9	22	11.6
Marital Status	Married	151	87.8	13	76.5	164	86.8
	Single	21	12.2	4	23.5	25	13.2

With regards to gender, both farmers and extension officers had higher proportions of male respondents (74.6%). This implies that the sugar industry of Swaziland is male-dominated. Worth noting again is that all (100%) of the sugarcane extension officers were also male. This observation provides an opportunity to encourage women to participate in this industry. The educational level of the farmers indicate that a majority (30%) had tertiary education with an almost similar number (29.6%) that had high school qualifications, while the rest never finished secondary school. Regarding the extension officers, all had gone through tertiary education and this is mainly due to the minimum requirement set by SSA for one to be employed as an extension officer.

Regarding the number of years of service, both farmers and extension officers indicated a high proportion (38.6%) having 1 – 5 years of service in the sugar industry. These

were followed by those respondents who had 11 – 15 years of experience (22.8%). Very few respondents had above 21 years of experience. A majority (86.8%) of them were married while the rest were single. From the results of the demographic variables, it could be concluded that most of them were educated middle-aged, married males, with 1 – 5 years sugarcane production experience.

Reliability analysis of the survey instrument

Cronbach's Alpha was used to determine the reliability of the instrument. Nunnally (1978) stated that a Cronbach's Alpha score of .70 or higher indicates a proof of internal consistency. As shown in Table 4 below, an acceptable reliability is reflected for each of the domains: .89 for Information-related barriers, .72 for organisation-related barriers, .92 for personal-related barriers, .88 for technology-related barriers and .86 for policy-related barriers.

Barriers preventing the use of ICT to access sugarcane production information

Research objective two aimed at determining the barriers that prevent the use of ICTs to access sugarcane production information via ICT as perceived by sugarcane farmers and their extension officers. Respondents were asked to rate their perceptions regarding the industry's barriers on the use of cell phones as one of the technologies for accessing information among the smallholder sugarcane growers, extension officers and other stakeholders in the sugar industry of Swaziland. The items were arranged into the five domains outlined in the conceptual framework; Information-related barriers; Organisation-related barriers; Human resource-related barriers; Technology-related barriers and Policy-related barriers. The results are presented in Table 2.

Table 2: Perceptions of barriers towards accessing sugarcane information by a cell phone as technology for communication.

Items	Farmers(N=172)		EOs(N=17)		Total (N=189)		
Information Related Barriers	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**CA**
Lack of information centres	3.97	1.488	5.06	.966	4.07	1.481	
Lack of training programs	2.93	1.473	3.18	1.741	2.95	1.496	
Unknown information sources	2.51	1.152	3.00	1.732	2.55	1.218	
Lack of simple reading material	2.57	1.219	4.06	1.819	2.70	1.348	
Lack of demonstration	2.58	1.237	3.59	1.805	2.67	1.324	

Items	Farmers(N=172)		EOs(N=17)		Total (N=189)		
Unreliable information sources	2.28	1.040	2.65	1.656	2.32	1.108	
Unknown language presentation	2.21	.969	3.12	1.867	2.29	1.104	
Information delivered not understood	2.22	.976	2.94	1.676	2.28	1.072	
	2.66	**.865**	**3.45**	**1.452**	**2.73**	**.955**	**.89**
Organization-related barriers							
Limited organization support	2.72	1.361	2.59	1.873	2.71	1.409	
Lack of good leadership	2.98	1.483	4.12	1.691	3.08	1.533	
Restricted use of cell phones by women	2.17	.847	2.29	1.213	2.19	.883	
Gender restriction on extension officers	2.08	.696	2.24	1.300	2.10	.766	
Lack of sugarcane E0's	2.27	1.048	2.00	1.541	2.24	1.098	
	2.44	**.636**	**2.65**	**1.211**	**2.46**	**.704**	**.72**
Personnel-related barriers							
Farmer interpersonal barriers	2.77	1.382	3.65	1.412	2.85	1.404	
Inability to use gadget	2.91	1.405	3.71	1.312	2.98	1.412	
Costs of gadget too high	3.46	1.583	3.94	1.519	3.50	1.580	
E0's are biased	2.56	1.191	2.06	1.088	2.51	1.188	
Lack of awareness in ICT's	2.65	1.296	3.18	1.811	2.69	1.353	
Lack of confidence in ICT's	2.76	1.320	3.35	1.618	2.81	1.355	
Lack of motivation to use ICT's	3.02	1.469	3.35	1.656	3.05	1.485	
Language problem in using ICT's	2.85	1.347	4.00	1.871	2.95	1.434	
Less preference to use ICT's	2.70	1.297	4.18	1.551	2.84	1.384	
Lack of skill to use ICT's	3.21	1.440	4.35	1.412	3.31	1.471	
No time to listen to radio programs	3.00	1.422	3.82	1.286	3.07	1.427	
Poor time management	3.04	1.407	3.94	1.249	3.12	1.415	
High illiteracy rate	3.75	1.590	4.00	1.936	3.77	1.620	
Untimely information delivery	2.80	1.345	3.94	1.519	2.90	1.396	
Lack of training on ICT's	3.31	1.573	3.76	1.715	3.35	1.587	
	2.99	**.937**	**3.68**	**1.121**	**3.05**	**.973**	**.92**
Technology-related barrier							
Lack of ICT equipment	3.25	1.571	4.82	1.334	3.39	1.613	
Lack of ICT infrastructure	3.42	1.571	5.12	1.111	3.57	1.608	
Costs of broadband too high	3.47	1.527	4.88	1.495	3.60	1.573	
Low computer literacy	3.71	1.566	5.29	.686	3.85	1.574	
Restricted use of ICT's	2.98	1.493	4.76	1.200	3.14	1.553	
Poor interconnectivity	2.84	1.401	4.71	1.160	3.01	1.479	
Network coverage weak	2.98	1.426	3.59	1.417	3.03	1.433	
	3.24	**1.120**	**4.74**	**.902**	**3.37**	**1.181**	**.88**
Policy-related barriers							
No government policies on ICT's	3.23	1.391	4.12	1.219	3.31	1.396	
Existing policies need improvements	3.05	1.350	4.29	1.359	3.16	1.394	
ICT related laws not supported	3.09	1.339	4.00	1.541	3.17	1.378	
Special rate policies not there	3.27	1.466	4.24	1.251	3.35	1.472	
ICT budget is limited	3.30	1.522	4.59	1.417	3.42	1.554	
	3.19	**1.132**	**4.25**	**1.069**	**3.28**	**1.164**	**.86**

They indicate that both farmers and extension officers perceived information-related barriers (M=2.76, SD=.86) and organizational structure barriers (M=2.46, SD=.72) not to hinder information access within the sugar industry of Swaziland.

A difference in perception between farmers and extension officers was observed in personnel barriers, Technology barriers and Policy barriers. In all the above mentioned

barriers, farmers disagreed that these barriers were a hindrance on the use of ICT to access information among the sugar industry stakeholders, whereas extension officers, on the other hand, agreed that these barriers were indeed a hindrance on the use of ICT for information access. These differences could be a result of the difference in the educational background of these two groups.

All the extension officers had gone up to tertiary level and were experts in the field which was not the case with the smallholder sugarcane farmers. Due to their education level, extension officers had a better understanding regarding the issues that hinder the use of ICT by farmers to access sugarcane production information. These issues as stated involved technology, policy and personnel. They require some degree of education or literacy level to understand them, which is not the case with the some of the smallholder farmers. For the technology barrier, farmers indicated a mean value of 3.24 (SD=1.12), whereas extension officers reported a higher mean value of 4.74 (SD=.92). The same difference was observed with policy barriers where farmers recorded a lower mean value of 3.19 (SD=1.13) and extension officers recording a higher mean value of 4.25 (SD=1.07). Regarding the personnel barriers, farmers exhibited a lower mean value of 2.99 (SD=.94) and a higher mean value for the extension officers (M=3.68, SD=1.12) was reported.

Differences in perceptions of barriers due to demographic variables

The third research objective of the study aimed at determining any significant deviation in the perceptions of respondents regarding the barriers based on the background and demographic variables. A series of one-way analysis of variance (ANOVA) were performed to observe if the responses of the participants differed according to age, gender, education level, experience, marital status and respondent's category. Five factors were investigated, including information-related barriers, organisational-related barriers, personnel-related barriers, technology-related barriers and policy-related barriers. The results are presented in Table 3.

Table 3: One-way ANOVA of barriers

	Category	N	Information			Organisation			Personnel			Technology			Policy		
			Mean	F-value	Sig	Mean	F-value	Sig	Mean	F-value	Sig	Mean	F-value	Sig	Mean	F-value	Sig

Age	19 - 29	27	2.87	.839	.50	2.36	.562	.69	2.95	.461	.76	3.43	.661	.62	3.04	1.35	.25
	30 - 39	73	2.65			2.41			3.10			3.50			3.48		
	40 - 49	36	2.62			2.48			2.89			3.14			3.13		
	50- 59	26	2.69			2.57			3.14			3.42			3.04		
	60 <	27	2.73			2.58			3.13			3.23			3.44		
Gender	Males	141	2.43	6.53	.01*	2.28	4.23	.04*	2.75	6.16	.01*	2.99	7.06	.01*	2.94	5.83	.02*
	Females	48	2.83			2.52			3.15			3.50			3.40		
Education	None	8	3.05	1.35	.25	2.70	2.52	.04*	3.66	1.64	.17	3.64	2.21	.07	3.43	2.33	.06
	Primary	30	2.56			2.37			2.89			3.03			2.95		
	Secondary	38	2.87			2.74			3.02			3.27			3.29		
	High school	56	2.56			2.31			2.91			3.24			3.09		
	Tertiary	57	2.85			2.44			3.20			3.71			3.62		
Experience	1 – 5	73	2.67	1.25	.29	2.41	1.76	.14	3.05	.42	.79	3.33	.20	.94	3.17	.79	.54
	6 – 10	35	2.77			2.54			2.99			3.39			3.37		
	11 – 15	43	2.61			2.49			2.95			3.49			3.36		
	16 – 20	16	2.70			2.13			3.19			3.22			3.04		
	21 <	22	3.13			2.69			3.23			3.34			3.57		
Marital	Married	164	2.71	.58	.45	2.47	.13	.72	3.03	.45	.50	3.35	.25	.62	3.32	1.44	.23
	Single	25	2.87			2.42			3.17			3.48			3.02		
Category	Farmer	172	2.66	11.1	.01*	2.44	1.28	.26	2.99	8.24	.01*	3.24	28.8	.01*	3.19	13.7	.01*
	EO	17	3.45			2.65			3.68			4.74			4.25		

*P < .05

The results indicate that age, marital status and sugarcane growing experience did not have any influence towards the perceptions of respondents for all the dependent variables. Only gender, education level and respondent's job category were found to have a significant difference on the perceptions of respondents. The ANOVA results indicated that the effect of gender was significant on all the dependent variables of *Information Barriers*, [F (1, 187) = 6.53, P<.01]; *Organisational barriers*, [F (1, 187) = 4.24, P < .04]; *Human resource barriers,* [F (1, 187) = 6.16, P < .01]; *Technology barriers*, [F (1,187) = 7.06, P < .01] and *Policy barriers*, [F (1, 187) = 5.83, P < .02]. The education level indicated a significant difference for one independent variable, organisational-related barriers, [F (4, 184) = 2.52, P < .04]. With regards to the respondent's job category, results indicated that it had an influence on Information-related barriers, [F (1, 184) = 1.1, P < .01], Human Resource barriers, [F (1,184) = 8.24, P < .01], Technology barriers, [F (1, 184) = 28.8, P < .01] and Policy barriers, [F (1, 184) = 13.7, P < .01].

Discussions and Implications

ICT has a great opportunity to change the means through which information, knowledge and new technology is handled, developed and disseminated to farmers through extension services. Sugarcane farmers require support from other intermediaries to adopt new information and knowledge. In this regard, extension services are recommended to be the ideal intermediary for disseminating information and knowledge straight to farmers. Therefore, the assessment of barriers that hinder the flow of information to farmers using ICTs is very crucial.

The study has demonstrated through the results from the second objective that sugarcane farmers and their extension officers do not perceive information-related barriers and organisation-related barriers as hindrances for accessing information through the use of ICTs by the sugar industry stakeholders. This perception implies that ICTs, especially cell phones, can be used effectively in the sugar industry to enhance information access among smallholder farmers, thus improving their productivity.

Regarding the perceptions of respondents on personnel-related barriers, technology-related barriers and policy-related barriers, the study findings indicated a disagreement between farmers and extension officers. Farmers disagreed that these barriers could hinder information access, while the opposite was true for extension officers. Extension officers perceived these barriers to hinder information access by the industry stakeholders.

The third research objective aimed at determining if demographic variables of respondents did have an influence on their perception regarding barriers to information access. The one-way ANOVA results indicate that age, marital status and sugarcane growing experience did not have any influence towards the perception of respondents in all the dependent variables. Only gender, education level and respondent's job category were found to have a significant difference on the perceptions of respondents. In line with prior studies (Muilenburg & Berge, 2005; Ong & Lai, 2006), gender in this study indicated a significant difference to all the barrier variables. Females scored higher means than males in all the dependent variables. This implies that females perceived these barriers as a hindrance to information access than their male counterparts. Purnomo and Lee (2010) found that gender had an influence on only organisational-related barriers. This could be caused by the imbalance between the total number of male to female respondents (25% female and 75% male). Educational level exhibited a significant difference in organisation-related barriers with those who had less education scoring higher means than those with higher education. This finding is also in line with what Purnomo and Lee (2010) reported. The respondent's job category is another demographic variable that indicated a significant difference in all the barrier factors except for organisational related barriers. Extension Officers scored higher mean scores than sugarcane farmers and this is an indication that Extension Officers perceived these barriers as a hindrance to information access among the sugar industry stakeholders.

Conclusion

The study has shown that the sugar industry is dominated by middle-aged, married males, educated with 1 – 5 years sugarcane production experience. Very few women are involved in the sugar industry in Swaziland and this provides an opportunity for the industry to promote women empowerment in this sector. The research has indicated that sugarcane farmers do not perceive any of these barriers to be a hindrance on the use of ICTs for information access. Extension Officers, on the other hand, only agreed with farmers on information-related barriers and organisation-related barriers. Their perception with regards to the other barriers differed from that of farmers in that they perceived human resource-related barriers, technology-related barriers and policy-related barriers to be a hindrance when it comes to the use of ICTs for information access. The study also aimed at identifying demographic variables that had an influence on respondents' perceptions of the barriers towards the use of ICTs for information access by the sugar industry. Results indicated that gender, education level and respondent's job category were found to have a significant influence on the perceptions of respondents. This implies that demographic variables must be considered when planning the use of ICTs, especially cell phones, to access sugarcane production information.

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CHAPTER 6: READINESS OF THE SWAZILAND SUGAR INDUSTRY TOWARDS THE USE OF ICT SPECIFICALLY CELL PHONES TO ACCESS INFORMATION: PERCEPTIONS OF SMALLHOLDER SUGARCANE FARMERS AND EXTENSION OFFICERS

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Abstract

The study investigates smallholder sugarcane farmers and extension officer's perceptions of readiness towards the use of ICT especially cell phones as a technology for accessing information within the Swaziland sugar industry. The target population of the census study were all smallholder sugarcane farmers and their extension officers. Data for the survey research were collected using valid and reliable questionnaires which were administered through an interview. Descriptive statistics and one way analysis of variance (ANOVA) were applied to analyse the data. The findings show that the majority of

respondents were educated middle aged, married males, with 1 – 5 years sugarcane production experience. The results revealed that sugarcane farmers and extension officers perceive the Swaziland sugar industry to be ready for the introduction and subsequent use of ICTs to access sugarcane production information. The sugar industry infrastructure and other facilities that are necessary for the use of cell phones were perceived to be ready for the implementation of the cell phone technology. All respondents were also found to possess cell phones which they personally owned. The entire sugar industry had access to cellular network and electricity. It was also shown that some of the demographic variables did have an influence on the respondent's perception of the industry's readiness towards the use of ICTs to access information. The results of this study can provide guidance to the government and the sugar industry of Swaziland when considering readiness towards implementing ICT information based programs.

Keywords: cell phone, sugarcane, extension, ICT, Swaziland, farmers, readiness

Introduction

In a rapidly changing world, agricultural extension has been recognised as an essential mechanism for delivering knowledge, Information and advice to a large majority of farmers (Richardson, 2003). Arkhi et al. (2008) noted that agricultural extension has an important role of connecting farmers and the research centres. The application of ICT in the field of agriculture has been reported from different parts of the globe. ICTs have an important role of assisting extension in transferring up to date information to farmers as well as reporting the needs of farmers to research centres. This process according to Arkhi et al (2008) reduces the costs of travelling by removing the physical distances that could have been travelled by extension personnel in trying to reach and assist rural farmers.

Agriculture is one of the most important sectors in Swaziland and sugarcane is one of the major cash crops grown in the country. The sugar industry sector is the backbone of the Swazi economy according to the National Adaptation Strategy of Swaziland. It contributes about 18 percent towards the Gross Domestic Product (GDP), 35 percent towards private sector wage employment and 11 percent to national wage employment. Sugarcane production in Swaziland takes place in the Lowveld part of the country due to its good soils and the favourable climatic conditions. The crop is grown under irrigation over a period of 11 to 12 months with annual harvests. This sector could benefit tremendously with the application of ICTs especially in bringing changes to the livelihoods of the poor in the rural areas of Swaziland.

One of the most popular ICT applications is e-learning. With e-learning, available technologies can be used to enhance learning and expand access to information and knowledge within the agricultural sector of Swaziland. The use of e-learning in the field of agricultural extension is becoming popular in many countries due to the development of ICT. Omotayo (2005) observed that frontline extension workers who become the direct link between farmers and other actors in the extension of agricultural knowledge and information systems are well positioned to make use of ICT to access expert knowledge or other types of information that could improve the farmer's ability to improve productivity.

ICT programme implementation in a developing country relies on various facets such as infrastructure, government policy, cultural factors, organisational factor and human resources. Human resources are one of crucial factors to help diffuse the ICT programme.

Hence this article focuses mainly on the human resources factors to investigate the readiness of the Swaziland sugar industry towards the use of ICTs (specifically cell phones), to access sugarcane production information. Assuming that these factors can be clearly identified, the information can be used by the sugar industry to increase the use of this approach of learning to improve sugarcane productivity among smallholder sugarcane growers in Swaziland. This will in turn have a positive impact on sustainable agricultural development and the economy of the country. The results will also serve as a valuable baseline of ICT diffusion within the sugar industry of Swaziland so that the growth or decline of this approach could be tracked.

Therefore the main purpose of this article was to investigate the readiness of the Swaziland sugar industry as perceived by smallholder sugarcane farmers and their extension officers on the use of ICTs to access sugarcane production information. The study was performed with the guidance of the following research objectives:

1. Describe respondents by demographic variables.
2. Determine the perceived readiness level of the Swaziland sugar industry towards the use of ICT to access sugarcane production information.
3. Determine the availability and usage of ICT hardware's within the sugar industry of Swaziland.
4. Explain if demographic variables of respondents (Age, gender, education, experience, marital status and respondent's category) do affect their perception of the sugar industry's readiness towards the use of ICTs to access sugarcane production information.

Literature Review

The use of Information and Communication Technology (ICT) is becoming more widespread in different sectors including agriculture. One of the most popular ICT applications is e-learning whereby available technologies are used to enhance learning and facilitate information access in the agricultural sector. The readiness of farmers and extension workers to use ICT in any community is an issue that needs to be addressed before that technology is introduced (Kauffman & Kumar, 2005). The assessment of ICT readiness

allows for proper planning for its integration so that efforts are focused in areas where further attention is required (Krull, 2003).

Readiness is defined by So and Swatman (2006) as being mentally or physically prepared for some activity or action. Trinidad (2002) emphasised that it is very crucial to conduct an initial assessment of preparedness for e-learning among farmers and extension workers before a new technology is introduced. Trinidad (2002) further explains that this assessment should consists of several technological factors such as computer, internet and telephone line readiness. Other factors to consider are educational and they include network learning, network society, network economy, network policy, English proficiency and computer literacy. Watkins (2003) proposed that the assessment for e-learning readiness should include technology access, technology skills, online reading and internet chat.

Some studies have indicated that demographic and background characteristics such as age, gender, ethnicity, marital status, level of education, experience with computers and internet have an influence on ICT adoption thus they need to be assessed too (Dundell & Thompson, 1997; Whitley, 1997; Teo & Lim, 2000; Muilenberge & Berge, 2005; Ong & Lay, 2006)

According to Darab and Montazer, (2011), infrastructure readiness assessment focuses on evaluating whether the existing infrastructure could sustain the new intervention and if not, such infrastructure must be provided. Human Resource readiness on the other hand focuses on evaluating the incumbents in terms of motivations, attitudes resistance and skills required in providing e-learning. Machado (2007) recommended that prior to the implementation of e-learning services it is important to understand the administrator's vision, their abilities in implementing policies and strategies that support e-learning and further highlights that policies and strategies help in capacitating other stakeholders in terms of motivation and training.

Methodology

The study was conducted in the year 2015 within the Lowveld region of Swaziland where sugarcane is mainly grown. The survey method using the interview technique was used in the study. This study also carried quantitative research to investigate the perceptions of sugarcane farmers and extension officer's readiness towards the use of ICT to access

sugarcane production information. Four enumerators who had recently graduated from the University of Swaziland were engaged and trained on how to collect the data. The study was a census and a structured questionnaire was used to interview all the smallholder sugarcane farmers (N=172) as well as all the sugarcane extension officers (N=17) who were actively growing sugarcane in Swaziland during the year of data collection.

A total of 201 questionnaires were issued to respondents and only 189 (172 famers and 17 extension Officers) were valid giving an effective response rate of 94%. Data was collected with a pre tested schedule. Descriptive statistics and one way analysis of variance (ANOVA) were applied to analyse the data using SPSS 20. The study aimed at determining any significant difference in the readiness perceptions of respondents due to background and demographic variables. A series of one-way analysis of variance (ANOVA) were performed to observe if the overall responses of the participants differ according to age, gender, education level, experience, marital status and respondent's category. For testing significant differences, the alpha level was set at 95% ($P < .05$). Frame, selection and non-response errors were controlled in accordance with suggestions by Miller and Smith (1983). An up to date list of all the active sugarcane growers was obtained from the Swaziland Sugar Association (SSA) extension services, thus controlling frame error. The list was then purged for duplication of names and for those growers who were no longer in the business of growing sugarcane and, to control selection error. A panel of experts consisting of two senior extension managers from SSA, one extension manager from The Food and Agricultural Organisation (Swaziland) and four academic staff members from the University of Swaziland, department of Agricultural Education and Extension were asked to review the instrument for content validity. Experts attested to the content validity of the instrument. A pilot test was conducted to determine the reliability of the questionnaire using cane growers from Vuvulane estates who did not participate in the study, Kuder Richardson (KR21) and Cronbach alpha procedures were used to calculate reliability coefficients of independent variables.

Data Collection Instrument

The questionnaire was divided into three parts: Part I listed items related to demographic variables and background information. Respondents were asked to circle their choices or fill information in the space provided. Part II contained items that would enable

the implementation and subsequent use of ICT to access information within the sugar industry of Swaziland. Respondents were asked to fill the information in the space provided or circle their choices against each item. Part III consisted of items pertaining to the readiness of respondents towards the use of ICT to access sugarcane production information. Respondents were asked to rate each item of readiness using a Likert type scale ranging from one (strongly disagree) to six (strongly agree). A cut off point of 3.5 was established such that all those responses with a mean value of less than 3.5 were categorised as having disagreed and all those above 3.5 were recorded as agreed.

Theoretical framework for the study

Extension exists to make agricultural information accessible to farmers and other stakeholders who need it to improve productivity (Salau, Saingbe, & Garba, 2013). Unfortunately, extension currently does not meet this goal. The public extension service, especially in the Sub-Saharan Africa region, has not been effective enough in conveying agricultural information to farmers. Farmers sometimes resist a much-needed improved technique not because they do not want it but because they are ignorant of the practice (Salau et al., 2013).

Masuki et al. (2010) argues that agricultural information plays an important role in the development of smallholder farmers towards increased production. He noted that most smallholder farmers are located in the rural areas, therefore an increase in their production automatically leads to a more desirable lifestyles for the rural people, food security and national economies of the countries where they operate. When reliable and accurate information is availed on time to smallholder farmers, they can reduce their production costs, improve their productivity, have collective bargaining with buyers and input suppliers, thus maximising their profit margins (Ikoja-Odongo & Ocholla, 2004; Masuki et al., 2010; Richardson, 1997).

As discussed in (Dlamini & Worth, 2018) [Chapter 4], a conceptual framework was developed to demonstrates the differences between smallholder farmers and large-scale famers with regard to accessing information via ICT – highlighting the influence of barriers, information management and readiness for ICT introduction.

In this context of farmers, extension and ICTs, readiness addresses four elements: the readiness of farmers to adopt/use ICTs to access information; the readiness of extension officers to adopt/use ICTs to access and disseminate information; provision of ICT infrastructure; and the ability to manage the communications infrastructure (Dlamini & Worth, 2018) [Chapter 4].

As shown in Figure 1, the readiness of smallholder rural farmers towards the use of ICT to access information is very low. This has a potential to create poor uptake and usage of ICT for information access, thus leaving smallholder farmers vulnerable to poor decision-making about the production and other operations of their farming enterprises which then leads to lower than possible yields. Conversely, Figure 1 also shows how prepared larger-scale farmers are for the introduction of ICT to access crucial information for improving their productivity.

This framework allows for separating out the causes of readiness or lack thereof to use ICTs in relation to information access and dissemination. This will facilitate policy and practical decisions in relation to making sure that any issues related to farmers and/or extension officers not being ready to use ICTs are accurately targeted. Similarly, issues related to the provision and management of ICT infrastructure can be clearly identified (and separated from other issues) and addressed accordingly.

Results and Discussions

The data discussed in this paper were analysed using the framework in Figure 1. Respondents were asked to rate how they perceive each of the readiness domains (farmers, extension officers, infrastructure and management) to be ready for the introduction of ICT to enhance information access.

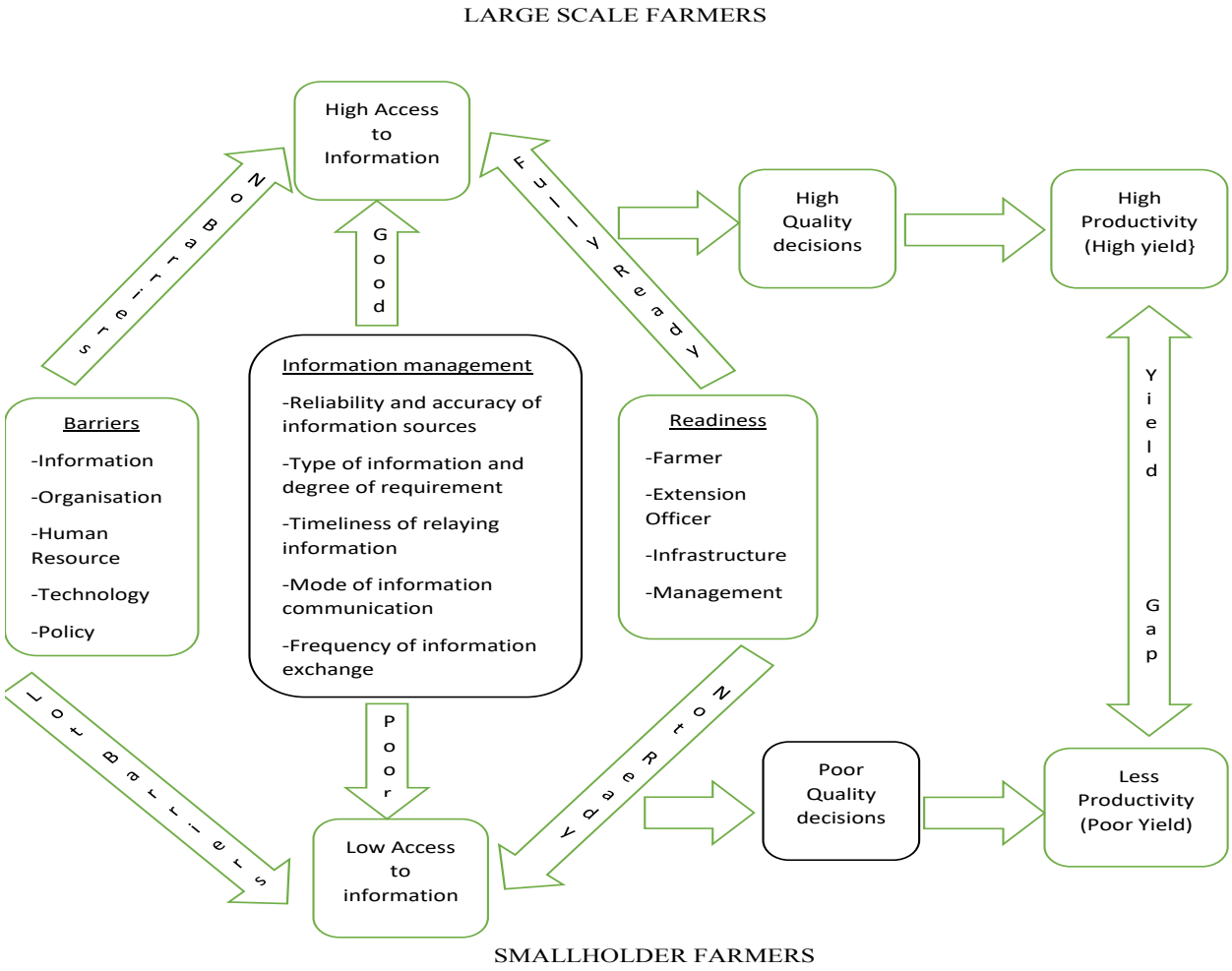

Figure 1: Diagrammatic representation of how information access influences the productivity gap between smallholder and large scale farmers.

The reporting of results and discussions have been organised into four sections. The first section describes demographic variables of respondents. The second section reports the perceived readiness level of respondents towards the use of ICT in accessing sugarcane production information. The items were arranged into four domains of farmer readiness, extension officer readiness, infrastructure readiness and extension management readiness. The third section reports the availability and usage of ICT hardware's within the sugar industry of Swaziland while the fourth section describes if demographic variables of respondents did affect their perception of the industry's readiness towards the use of ICTs in accessing sugarcane production information?

Respondents Demographic Variables

Respondents were described according to their demographic variables including age, gender, education level, sugarcane production experience and marital status. Results are presented in Table 1, and they reflect that the majority of the respondents are in the age group of 30 – 39 years (38.6%) followed by 40 - 49 years (19%) group for both farmers and extension officers. With respect to gender, both farmers and extension officers had higher proportions of male respondents (74.6%).

From the results, it is evident that the sugar industry of Swaziland is still male dominated when it comes to leadership of the small holder farmer groups. Worth noting again is that all (100%) the sugarcane extension officers were male. This observation opens the need to encourage women to tap into this industry. The educational status of the farmer respondents show that the majority (30%) had gone up to tertiary education followed by (29.6%) who went as far as high school and the rest never finished secondary school.

Regarding the extension officers, all had gone through tertiary education and this is mainly due to the minimum requirement set by SSA for one to be employed as an extension officer. With regards to the number of years of service, both farmers and extension officers had the majority of respondents (38.6%) with 1 – 5 years of service in the sugar industry. These were followed by those respondents (22.8%) who had 11 – 15 years of experience. Very few were above 21 years of experience. The marital status of respondents indicate that the majority (86.8%) were married and the rest were single. So it could be concluded from the results of the demographic variables that most of the study respondents were middle aged, married males, educated with 1 – 5 years sugarcane production experience. An educated individual in the Swazi context refers to someone who has completed high school education and a middle aged person is one falling between 30 to 39 years of age.

Table 1: Respondents' demographic profile

		Farmer (N=172)		EOs (N=17)		Total (N=189)	
Characteristic	Category	F	%	F	%	F	%
Age	19 – 29	24	13.9	3	17.6	27	14.3

	30 – 39	64	37.2	9	53.0	73	38.6
	40 – 49	32	18.6	4	23.5	36	19.0
	50- 59	25	14.5	1	5.9	26	13.8
	> 60	27	15.8	0	0	27	14.3
Gender	Males	124	72.1	17	100	141	74.6
	Females	48	27.9	0	0	48	25.4
Education	None	8	4.7	0	0	8	4.2
	Primary	30	17.4	0	0	30	15.9
	Secondary	38	22.1	0	0	38	20.1
	High school	56	32.6	0	0	56	29.6
	Tertiary	40	23.3	17	100	57	30.2
Experience	1 – 5	69	40.1	4	23.5	73	38.6
	6 – 10	28	16.3	7	41.2	35	18.5
	11 – 15	40	23.3	3	17.6	43	22.8
	16 – 20	14	8.1	2	11.8	16	8.5
	21 <	21	12.2	1	5.9	22	11.6
Marital Status	Married	151	87.8	13	76.5	164	86.8
	Single	21	12.2	4	23.5	25	13.2

Farmer readiness

Research objective two sought to determine the perceived readiness level of the Swaziland sugar industry towards the use of ICT in accessing sugarcane production information. The results are presented in Table 2 below and they indicate an overall mean score of M=4.37 (SD =.95) on famer's readiness towards the use of ICT for information access within the sugar industry. This mean score implies that farmers are perceived by the majority of respondents to be ready for the use of ICT specifically cell phones as a technology for disseminating information within the sugar industry of Swaziland. This is also supported by the fact that the majority of the sugarcane farmers possessed cell phones which they personally owned and were already using these gadgets to disseminate work related information within and outside their work stations. It was also highlighted that most of these farmers were using their own airtime to communicate work related issues during and after working hours.

Table 2: Perception of readiness towards the use of ICT to access sugarcane production information

Items	Farmers (N=172)		EOs (N=17)		Total (N=189)		
Farmer Readiness	M	SD	M	SD	M	SD	CA
Farmers know that ICT's can be used	4.60	1.20	4.53	.94	4.59	1.18	
Farmers are capable of using ICT's	4.66	1.04	4.06	.97	4.61	1.04	
Farmers have the skill to use ICT's	4.18	1.29	3.18	1.24	4.09	1.32	

Farmers are ready to use ICT's	4.48	1.24	3.76	1.20	4.41	1.26	
Internet access is not a farmers problem	4.18	1.44	3.53	1.74	4.12	1.48	
Overall	4.42	.94	3.81	.89	4.37	.95	.81
Extension Officer Readiness							
E0's know how to use ICT's	4.99	.79	5.47	.51	5.04	.79	
ICT's can improve extension	5.10	.56	5.35	.49	5.13	.56	
Now is the time to promote ICT usage	5.18	.48	5.41	.51	5.20	.49	
E0's are ready to integrate ICT in their extension programs	5.10	.63	5.18	.73	5.11	.64	
E0's have enough ICT competency	5.13	.47	5.06	1.09	5.13	.55	
Overall	5.10	.47	5.29	.45	5.12	.47	.82
Infrastructure Readiness							
Infrastructure supports ICT implementation	5.02	.78	4.41	.87	4.96	.81	
Adequate ICT support from industry	5.10	.64	4.71	1.21	5.07	.72	
Industry has enough budget to support ICT usage	5.14	.52	4.94	.97	5.12	.58	
Overall	5.09	.50	4.69	.76	5.05	.54	.75
Management Readiness							
Extension management knows ICT	5.25	.58	5.53	.72	5.28	.60	
Extension management supports ICT	5.19	.65	5.06	.75	5.17	.66	
Management has a plan for ICT implementation	5.25	.58	5.53	.72	5.28	.60	
Overall	5.22	.59	5.29	.69	5.22	.60	.90

Extension officer readiness

Overall perception of extension officer Readiness towards the use of ICT has a mean score of M=5.12 (SD = .84) as indicated in Table 2. This mean score indicates that all respondents perceive extension officers to be ready for the implementation of cell phones as a technology for disseminating information within the sugarcane industry stake holders. All extension officers interviewed possessed personal smart phones and all had gone through tertiary education which makes them ready for the introduction of such a technology. All respondents agreed that extension officers, with their high ICT competency can improve their teaching and learning by integrating such technology in their extension programs. Respondents also agreed that this is the right time for promoting the dissemination of information within the sugar industry of Swaziland.

Infrastructure readiness

Results shown in Table 2 indicates a mean score of M=5.05 (SD = .54) on infrastructure readiness for the use of ICT within the sugar industry. This is an indication that most respondents agreed that the infrastructure in the sugar industry of Swaziland is perceived to be ready for the use of cell phones as a technology for information dissemination. Respondents reported that they all have access to the cell phone network in their respective areas where sugarcane is grown. Network coverage is very crucial for cell

phone connectivity. Electricity which supplies energy to the satellites and recharge cell phones was reported to be accessible by all the respondents in their respective areas of sugarcane production. The availability of cell phone service centres within the vicinity of each mill makes it easy for the respondents to get immediate help when their cell phones have a problem. Airtime is also readily available in almost all the small grocery shops situated within the farmer's residential areas.

Management readiness

Management is perceived by most respondents to be ready for the use of ICT to circulate information within the sugar industry of Swaziland. This is indicated by the overall mean score of M=5.22 (0.60) in Table 2. Respondents agreed that extension management know how to use ICTs specifically cell phones and the use of such technology was supported. They went on to confirm that a plan for the implementation of ICT usage was on the pipeline.

Hardware availability and usage

Any organisation that aims at adopting the use of ICT to access information must have at least the minimum hardware requirements and soft wares to use that hardware. ICT hardware's include the physical equipment that will enable the sugar industry stakeholders to communicate effectively. Without appropriate equipment and easy access, it is quite hard to access information via ICTs (Oliver & Towers, 2000). Broadbent (2001) however stated that this does not require a huge infrastructure. A well working internet connectivity and enough supply of communication gadgets would be enough for an effective communication system.

Objective three of the study therefore enquired from both farmers and extension officers about the hardware availability and usage within the sugar industry, in particular, the focus was on the cell phone technology, the internet and other factors associated with mobile cellular usage. The results are presented in Table 3. These factors included cell phone possession, cell phone ownership, cell phone brand, social media, transport, mobile network coverage, electricity availability, distance from the mill and type of cell phone used.

Cell phone possession and ownership

Table 3 indicates that all farmers and extension officers (100%) in the sugar industry possessed cell phones and these cell phone gadgets are used in disseminating work related information among the Swaziland sugar industry stakeholders on a daily basis.

Table 3: Network and cell phone accessories

		Farmer (N=172		EOs (N=17)		Total (N=189)	
Variable	Category	F	%	F	%	F	%
Possession	Yes	172	100	17	100	189	100
	No	0	0	0	0	0	0
Ownership	Personal	166	96.5	17	100	183	96.8
	Company	6	3.5	0	0	6	3.2
Brand	Nokia	125	72.5	9	52.9	134	70.9
	Samsung	21	12.3	5	29.4	26	13.8
	Huawei	8	4.7	1	5.9	9	4.8
	ZTE	6	3.5	0	0	6	3.2
	Other	12	7	2	11.8	14	7.4
Type	Regular phone	108	62.8	4	23.5	112	59.3
	Smartphone	64	37.2	13	76.5	77	40.7
Social media	Yes	99	57.6	14	82.4	113	59.7
	No	73	42.4	3	17.6	76	40.2
Network	Available	172	100	17	100	189	100
	Not available	0	0	0	0	0	0
Electricity	Available	172	100	17	100	189	100
	Not available	0	0	0	0	0	0
Transport	Foot	111	64.5	0	0	111	58.7
	Bicycle	15	8.7	0	0	15	7.9
	Motorbike	6	3.5	0	0	6	3.2
	Vehicle	40	23.3	17	100	57	30.2
Mill distance	6 – 19	12	7	1	5.9	13	6.9
	20 – 39	137	79.6	11	64.7	148	78.3
	40 – 59	11	6.4	4	23.5	15	7.9
	60 <	12	7	1	5.9	13	6.9

With regards to ownership of these gadgets, the study revealed that a majority of the respondents (98.6%) personally owned the cell phones, while only 3.2% reported that they were using company owned gadgets. All the respondents reported that they use their own airtime to disseminate work related information using their cell phones. This is an indication that smallholder sugarcane farmers and their extension officers have realized the importance of using the cell phone technology in the dissemination of information timely and accurately among themselves and other sugarcane stakeholders.

Cell phone type and brand – The majority of the respondents reported that they were using the Nokia brand (70.9%) of cell phones followed by the Samsung brand (13.8%) as shown in Table 3. This could be attributed to the fact that these brands are readily available in the market, affordable and easy to fix. With regards to the type of cell phone

being used by the respondents, most reported that they were using the regular type (59.3%) of phone mainly because they were cheaper and less complicated to use. Only 40.7% of the respondents reported that they were using smartphones. Regular phones are cheaper and easy to operate where as smart phones are expensive and require a certain level of skill to operate them.

Network and electricity - As Table 3 illustrates, all smallholder sugarcane farmers and their extension officers reported that they have access to cellular network almost everywhere within the sugar industry of Swaziland. The only difference reported was the strength of the cellular network as some places had weaker connections than others. Topography and satellite distribution does influence the network strength of a given area. Regarding electricity, all respondents reported that they had access to electricity in their homes and that is where they recharge their cell phones. This is mainly due to the Rural Electrification project driven by the government of Swaziland which has seen a number of rural areas being provided with affordable electricity. The availability of electricity and mobile cellular network within the sugar industry of Swaziland has made the sugar industry to be ready for the implementation of most ICT programmes especially the use of cellular phones.

Transport and Distance from the mill - The study revealed that most respondents (58.7%) travel by foot while carrying out their day to day sugarcane production activities. Only 41.3% are using cars, motorbikes and bicycles. The use of cell phone to disseminate information helps in reducing the distance travelled by the farmers and their extension officers whenever they want to share information. The study also revealed that most respondents were within a radius of 20 to 39 km (78.3%) from the mill. Most input suppliers and service providers in the sugar industry are located next to the sugar mills. The use of cell phones helps both farmers and extension officers to acquire information accurately and timely from such institutions thus reducing the travelling costs. Such an arrangement also increases the time spent on supervising different daily activities in the farm thereby improving productivity.

Social media - Grouping farmers in order to be able to share information to them as a group while they physically remain in their respective workstations is very important. This can best be achieved by the use of social media accessible via cell phones. The study revealed as shown in Table 3 that more than half of the respondents (59.7%) are not yet connected to

any social media. Only 40.3% are connected and this presents a need to educate and encourage the respondents to use social media for accessing new information on sugarcane production.

Demographic variables of respondents

The fourth research objective of the study aimed at determining any significant difference in the readiness perceptions of respondents due to background and demographic variables. A series of one-way analysis of variance (ANOVA) were performed to observe if the overall responses of the participants differ according to age, gender, education level, experience, marital status and respondent's category. The results are presented in Table 4.

Table 4: One-way ANOVA of readiness

Variable	Category	N	Farmer readiness			Extension Officer readiness			Infrastructure readiness			Management readiness		
			Mean	F-value	Sig	Mean	F-value	Sig	Mean	F-value	Sig	Mean	F-value	Sig
Age	19 - 29	27	4.24	2.83	.026*	5.06	.832	.507	4.96	1.46	.214	5.22	.285	.887
	30 - 39	73	4.20			5.18			5.00			5.25		
	40 - 49	36	4.61			5.02			5.22			5.19		
	50- 59	26	4.18			5.15			5.19			5.13		
	60 <	27	4.78			5.13			5.05			5.30		
Gender	Males	141	4.36	.002	.961	5.13	.047	.829	5.09	4.14	.043*	5.27	.376	.540
	Females	48	4.37			5.12			5.19			5.21		
Education	None	8	4.25	2.10	.083	5.08	1.78	.143	5.13	1.43	.227	5.38	1.40	.239
	Primary	30	4.39			4.94			5.07			5.07		
	Secondary	38	4.72			5.21			5.19			5.34		
	High school	56	4.34			5.10			5.06			5.29		
	Tertiary	57	4.16			5.18			4.93			5.15		
Experience	1 – 5	73	4.33	3.69	.006*	5.13	1.49	.207	5.10	1.89	.114	5.25	3.08	.017*
	6 – 10	35	4.42			5.19			5.05			5.43		
	11 – 15	43	4.41			5.08			4.98			5.10		
	16 – 20	16	3.65			4.90			4.79			4.88		
	21 <	22	4.80			5.23			5.23			5.32		
Marital	Married	164	4.38	.497	.482	5.14	1.44	.231	5.10	10.4	.001*	5.26	4.11	.044*
	Single	25	4.24			5.02			4.73			5.00		
Category of respondents	Farmer	172	4.42	6.51	.012*	5.10	2.58	.110	5.09	8.82	.003*	5.22	.248	.619
	EO	17	3.81			5.29			4.69			5.29		

*P < .05

Age - The results in Table 4 indicates that age had an influence on respondent's perceptions towards farmer readiness [F (4, 184) = 2.83, P = .027]. The study demonstrated that the age range 60 < years old is more positive in the perception of farmer readiness and this finding is in line with different studies which have examined the effect of age differences on technology adoption (Burton-Jones & Hubona, 2003; Venkatesh et al., 2003; Rezai et al., 2008).

Gender - The study revealed that gender had an influence on respondent's perception towards infrastructure readiness [F (1, 187) = 4.14, P =.043]. Many authors (Teo & Lim, 2000; Young, 2000; Muilenburg & Berge, 2005, Joiner et al., 2005; Ong & Lay, 2006) have reported significant differences between genders in the adoption behaviour of ICTs, however, the unbalanced proportion of males to females (74% males and 26% females) could also not be ruled out as a cause for this difference.

Experience - Sugarcane production experience was found to have influence on the perceptions of respondents towards two variables of readiness and these were farmer readiness [F (4, 184) = 3.69, P =.006] and management readiness [F (4, 184=3.08, P = .017]. A strong positive perception of readiness among respondents with more experience was observed for both farmer readiness variable and management readiness variable.

Category of respondents - Table 4 indicates that this independent variable had an influence on respondent's perceptions towards two variables which are farmer readiness [F (1, 187) = 6.51, P =.012] and infrastructure readiness [F (1, 187) = 8.82, P=.003]. Farmers viewed themselves more positive in terms of readiness whereas extension officers were less positive. With regards to infrastructure readiness, extension officers were more positive on its readiness. These differences could be attributed to the unbalanced proportion of extension officers to farmers (91% farmers and 9% extension officers)

Education level was the only independent variable which did not have any influence on the perceptions of respondents towards the sugar industry's readiness. This therefore implies that there is a need to consider those variables which have an influence towards respondent's perception when considering implementing the use of ICT to access sugarcane production information in Swaziland. Extension officer readiness was the only dependent variable that was not influenced by any of the independent variables.

Conclusion and recommendations

Cell phones have a huge potential to revolutionise the way information knowledge and new technology is managed, developed and delivered to farmers. Small holder sugarcane farmers need assistance from intermediaries to adopt knowledge and information. In that regard, extension officers are suggested to be the effective intermediaries for delivering information and knowledge to sugarcane famers. Therefore assessment of readiness of both

farmers and extension officers towards the use of cell phones as communication technology is very crucial.

The findings of the research have shown that all four factors of readiness have been perceived as ready for the implementation of cell phone technology. These readiness factors include farmer readiness, extension officer readiness, infrastructure readiness and management readiness. This findings inform the sugar industry and the government of Swaziland that they can embark on implementing cell phone technology as means of disseminating information within the sugar industry. The implementation of such a technology can cut down the costs of travelling and maximise time spent on other production issues within the farm thus improving productivity. Accurate and timely information will be disseminated within a shortest time possible thus improving the knowledge capacity of the smallholder farmer and also improving their decision making abilities.

With regards to the basic required mobile communication facilities within the Swaziland sugar industry, the study demonstrated a high readiness level as perceived by the respondents. All farmers and extension officers possessed personally owned cell phones which they use to disseminate information during and outside working hours. They also reported to have access to both network and electricity in almost all their respective areas where they grow their sugarcane. The availability of cellular network and electricity is very crucial in the implementation of the cell phone technology for information dissemination. Most farmers are using the regular type of phone which has less functions compared to the smartphone. This may limit the farmers accessing information in the internet or in a form of videos or pictures. There is a need therefore to train these farmers to upgrade themselves to smart phones so that they get more information via their cell phones. Most of the farmers travel by foot when conducting their daily activities and this has a negative impact when it comes to gathering or disseminating information timely. The use of cell phone technology as a communication gadget can mitigate this challenge.

Based on these findings, the sugar industry of Swaziland can effectively use the presented scenario of mobile cellular technology to improve information access among its sugarcane production stakeholders especially smallholder farmers. This could be through ensuring that every smallholder sugarcane farmer is provided with a smart phone, taught how to use it and could be provided with minimum airtime on a monthly basis. The overall cost of these could be deducted from the proceeds of their harvest as is the case with other

production inputs. Another opportunity that exists is that of negotiating for a group treatment of the sugarcane farmers from the mobile service provider where benefits of special rates and the ability to send group information to farmers could be discussed.

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CHAPTER 7: INFORMATION MANAGEMENT USING ICTs TO ACCESS SUGARCANE PRODUCTION INFORMATION IN SWAZILAND: PERCEPTIONS OF SMALLHOLDER SUGARCANE FARMERS AND EXTENSION OFFICERS

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Abstract

The sugar industry of Swaziland has the greatest potential for improving rural livelihoods and at the same time eradicate poverty through increased productivity. This paper investigates the manner in which sugarcane information and knowledge is managed via ICTs within the sugar industry of Swaziland to improve smallholder farmer productivity. The study was a census involving all active smallholder sugarcane farmers (N=172) and their Extension officers (N=17). Quantitative data was collected through face to face interviews using structured questionnaires and the data was analysed using SPSS version 20 statistical software. The results of the study revealed that most of the respondents were middle aged, married males, with tertiary education levels and 1 – 5 years sugarcane production experience. Almost all the farmers owned mobile phones which they mainly utilized for accessing sugarcane production information. Most respondents highlighted that they frequently use their mobile phones to relay information via voice calls. The Swaziland Sugar Association emerged as the main source of production information and capable of relaying information on time. The study also revealed that the highest frequency of communication within the sugar industry is between farmers and extension officers and visits between the two are most frequently initiated by requests from farmers. All the sugarcane production information from land preparation, planting, irrigation, weed control up to harvesting were rated by all respondents as highly required. These findings are crucial in the development of an improved information management system that will empower smallholder sugarcane farmers in decision making thereby improving their productivity.

Key words: Knowledge Management, ICT, Extension, Swaziland, Productivity, Sugarcane.

Introduction

Knowledge management refers to a process of understanding a phenomena with an acceptable degree of familiarity obtained through exposure, involvement or contact (Seidman & McCauley, 2005). It involves processes and practices that have to do with the innovation, attainment, distribution and use of knowledge, skills and expertise. This then follows a circular non-stop process that continually updates itself. Knowledge is made of a number of attributes which include attitudes, experiences and skills that makes an individual to effectively perform a specific function. (Ethiopia, 2012).

For farmers to improve their productivity and consequently maximise their profit margins, they need timely and relevant information and knowledge that is accessible to them, otherwise agricultural production and food security will remain low and agricultural households will remain trapped in poverty.

There is a need for farmers to be involved in the entire knowledge management process if they are to experience satisfying outcomes. This is important because it will allow a better alliance of both tacit and explicit knowledge. The reception of the information that has been innovated out of this process is more likely to be high amongst the farmers as it would have included knowledge and practices developed and passed on to them through generations. Through the sharing of experiences, farmers can also enhance their current indigenous knowledge which is also very crucial for improved productivity. To improve knowledge amongst the farmers, the information must be codified, made explicit, and upgraded or modernized with research based evidence (Ethiopia, 2012).

A number of organisations are involved in the generation and improvement of information and knowledge. Different intermediaries are also effectively involved in forwarding information and knowledge to end users. Agricultural knowledge is generated from modern and traditional sources. Traditional sources refers to the indigenous knowledge and practices of rural communities and this type of knowledge is generated outside the formal school system. Modern knowledge on the other hand is developed through scientific research by research organisations and institutions of higher learning (Ethiopia, 2012).

Ethiopia (2012) noted that agricultural information and knowledge generated from various origins is first kept in different formats including publications, audio visuals and websites before it is distributed for adoption by users. The end users of the stored knowledge

and information include rural farmers who receive it via trainings, demonstrations, media and many others.

ICT can play and important role in the development of a fast and less costly knowledge management. Effective improvement in agricultural needs full exposure to information and knowledge in all aspects of production, processing and marketing. ICT shows potential to play that role in the [two-way] delivery of information in both developed and developing countries (Zijp, 1994). ICTs can be used as a tool for contributing directly to agricultural productivity or an indirect tool for enabling farmers to develop informed and quality decisions, for improved productivity.

Purpose

The main purpose of the article was to investigate how information and knowledge is managed through the use of ICTs, specifically cell phones, as perceived by smallholder sugarcane farmers and extension officers within the sugar industry of Swaziland. The study was guided by the following research objectives:

1. Explain the demographic variables of respondents.
2. Determine the type of information required by respondents and its degree of requirement.
3. Identify reliable and accurate sources for sugarcane production information.
4. Establish which source has the ability to relay information timely and accurately to farmers
5. Establish the type of ICT that is commonly used to relay information among the sugar industry stake holders.
6. Determine how frequent do farmers communicate with other stakeholders using their mobile phones to access sugarcane production information.

Methodology

The study was conducted in the year 2015 within the Lowveld region of Swaziland where sugarcane is mainly grown. The methodology used in this study was the survey method using the interview technique. This study carried quantitative research to investigate how information is managed within the sugar industry stakeholders as perceived by

sugarcane farmers and extension officers. Four enumerators who had recently graduated from the University of Swaziland were hired and trained on how to collect the data. The study was a census and a structured questionnaire was used to interview all the smallholder sugarcane farmers (N=172) as well as all the sugarcane extension officers (N=17) actively growing sugarcane in Swaziland during the year of data collection.

A total of 201 survey instruments were administered to respondents and only 189 (172 famers and 17 extension officers) produced the desired results and that translated to an effective response rate of 94%. Data were collected with a pre-tested schedule. Descriptive statistics were applied to analyse the data using SPSS 20. Frame-error, selection-error and non-response error were managed in line with suggestions by Miller and Smith (1983). An updated list of all current and active smallholder sugarcane farmers was obtained from the Swaziland Sugar Association (SSA) extension services, thereby managing frame-error. Farmers who appeared on the list yet were no longer growing sugarcane were removed to control selection error. A group of experts consisting of two extension managers from SSA, one extension manager from FAO (Swaziland) and four academic staff members from the University of Swaziland, Department of Agricultural Education and Extension were requested to check the instrument for content validity. The content validity of the instrument was approved by the experts. To determine the reliability of the instrument, a pilot test was conducted involving smallholder sugarcane growers from Vuvulane Sugar Estates who did not participate in the study. To compute the reliability coefficients of independent variables, the study employed Kuder Richardson (KR21) and Cronbach Alpha procedures.

Theoretical framework for the study

Extension exists to make agricultural information accessible to farmers and other stakeholders who need it to improve productivity (Salau, Saingbe, & Garba, 2013). Unfortunately, extension currently does not meet this goal. The public extension service, especially in the Sub-Saharan Africa region, has not been effective enough in conveying agricultural information to farmers. Farmers sometimes resist a much-needed improved technique not because they do not want it but because they are ignorant of the practice (Salau et al., 2013).

Masuki et al. (2010) argues that agricultural information plays an important role in the development of smallholder farmers towards increased production. He noted that most smallholder farmers are located in the rural areas, therefore an increase in their production

automatically leads to a more desirable lifestyles for the rural people, food security and national economies of the countries where they operate. When reliable and accurate information is availed on time to smallholder farmers, they can reduce their production costs, improve their productivity, have collective bargaining with buyers and input suppliers, thus maximising their profit margins (Ikoja-Odongo & Ocholla, 2004; Masuki et al., 2010; Richardson, 1997).

As discussed in Dlamini & Worth (2018) [Chapter 4], a conceptual framework was developed to demonstrates the differences between smallholder farmers and large-scale famers with regard to accessing information via ICT – highlighting the influence of barriers, information management and preparedness for ICT introduction.

Figure 1 demonstrates how information management influences access to information by smallholder farmers which ultimately affects their yield. This fosters poor-decision making about the production and other operations of their farming enterprises which then leads to lower than possible yields. Conversely, Figure 1 also shows how, for larger-scale farmers, information management improves access to information. The framework proposes that the factors affecting information management include: Reliability and accuracy of information; Type and degree of information requirement; Timeliness of relaying information; Mode of information communication; and Frequency of information exchange.

Literature Review

The attainment of effective knowledge management requires a logical and comprehensive engagement among stakeholders which include farmers, organisations, information generators, policy makers, extension officers and the private sector(Mchombu, 2009; Wen, 2009) Knowledge management is an important tool that can be used by different stakeholders in sugarcane production to achieve success through competitiveness, innovativeness, and responsiveness (Alavi & Leidner, 2001; Gao et al., 2002; Liao, 2003; Marouf, 2004; Nonaka & Konno, 1998; Quintas & Ray, 2002; Zheng, 2009). Kiessling, Richey, Meng, and Dabic (2009) defined knowledge management as an on-going process that leads to the identification and exploitation of current knowledge and opportunities and the creation of new knowledge and opportunities. An effective system of information management identifies clearly the type of information needed and its reliable and credible sources. It also establishes the degree of requirement and the communication mode, the

storage, accuracy and reliability of information (Quintas, Lefrere, & Jones, 1997).

Reliability and accuracy of information sources - Smallholder farmers are limited by a variety of constraints, many of which are caused by lack of reliable and accurate information to make good decisions. Increasing the value of ICT resources available to farmers is crucial in making smallholder agriculture highly productive. The correct placement and utilisation of ICT is central to this improvement and the basic function of extension as explained by Christoplos (2010) remains that of transferring and exchanging of practical information for the farmer to improve his outcomes. McNamara (2009) noted that smallholder farmers encounter higher information costs, due to their isolation as well as the poor state of their ICT infrastructure. To realise benefits of reliable and accurate information, it is essential that farmers and extension officers put in place a knowledge management system that relates to the nature of their work and what they intend to produce (Ndoro, 2011).

Type and degree of information requirement - Burton-Jones and Hubona (2006) argued that the challenge with most underdeveloped communities is that the farmers are not aware of what type of information they need. They further do not know what information is at their disposal to help them solve their challenges. The strengthening of linkages by extension among the sugar industry players also enables the free flow of vital information for improved productivity especially among the disadvantaged smallholder sugarcane farmers.

Timeliness of relaying information - Timely dissemination of critical information to different stakeholders for quality decision-making is very important and this could be facilitated through the use of ICT. According to Meyer et al. (2011) information is one of the most valuable resources for improving productivity among smallholder sugarcane farmers and extension is ideally positioned to facilitate its free flow within all the sugar industry stake holders. Correct and timely information can help smallholder sugarcane farmers to make quality decisions and take appropriate action. To facilitate development and hence improve productivity, important information needs to be made available on time and made accessible through the use of ICT particularly to the smallholder sugarcane growers.

Mode of information communication - The availability of communication infrastructure, especially in the rural areas where most of the smallholder growers are located should be a priority for the government if productivity is to be improved. One of the ways through which extension can reach a large number of farmers is to use ICT and that includes mobile telephony, cutting edge television and radio programs, video shows, information kiosks, web portals, rural tele-centers, farmer call centers and video conferencing. It will also reduce the costs associated with the way in which they disseminate information (Masuki et al., 2010).

Frequency of information exchange - The introduction of ICT has improved the way in which information can be shared among individuals. It has provided better ways to share and integrate information. Information sharing within and between organizations has become an important factor in the effort to improve productivity in many organizations (Newcomer & Caudle 1991). Agricultural extension builds upon information exchange and this has been diagnosed as an area in which ICT can have a great impact (Masuki et al., 2010). It is widely acknowledged that extension officers, who are a crucial connector between farmers and other actors, in the dissemination of agricultural knowledge and information are well located to use ICT to access expert knowledge that will in turn be used to improve smallholder farmer's knowledge (Adebayo & Adesope, 2007; Omotayo & Adedoyin, 2005).

Results and discussion

The framework for analysing the data was drawn from the conceptual framework below.

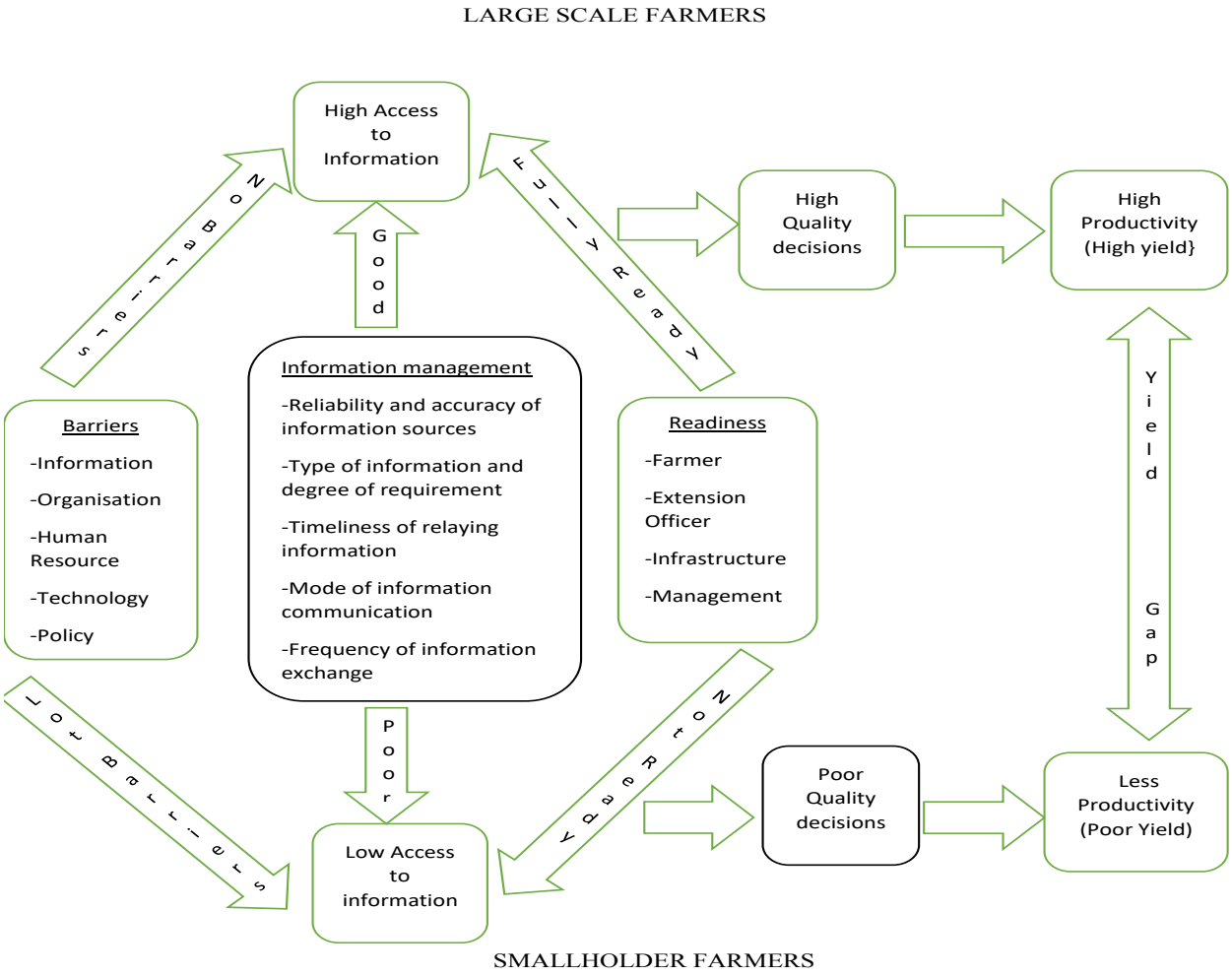

Figure 1: Diagrammatic representation of how information access influences the productivity gap between smallholder and large scale farmers.

Respondents Demographic Variables

To present a better insight into the participants, respondent's demographic variables on age, gender, education level, sugarcane production experience, marital status and job category, a summery is presented in Table 1. Findings from Table 1 indicate that most of the respondents fall in the age group category of 30 – 39 years (38.6%) followed by those in the range of 40 -49 years (19%) of age for both farmers and extension officers. With respect to gender, both farmers and extension officers had a majority of male respondents (74.6%) than the female counterparts. It is evident that the sugar industry of Swaziland is still male dominated when it comes to leadership of the small holder farmer groups.

Worth noting again is that all (100%) of the sugarcane extension officers were male. This observation opens the need to encourage women to tap into this industry. The educational status of the farmer respondents show that the majority (30%) had gone up to tertiary education followed by those (29.6%) who went as far as high school and the rest never finished secondary school. Regarding the extension officers, all had gone through tertiary education. This is mainly due to the minimum requirement set by SSA for one to be employed as an extension officer. With regards to the number of years of service, both farmers and extension officers had most of the respondents (38.69%) with 1 – 5 years of service in the sugar industry. These were followed by those respondents (22.8%) who had 11 – 15 years of experience. Very few were above 20 years of experience. The marital status of respondents indicate that the majority (86.8%) were married and the rest were single.

Table 1: Respondents' demographic profile

		Farmer (N=172)		EOs (N=17)		Total (N=189)	
Characteristic	Category	F	%	F	%	F	%
Age	19 – 29	24	13.9	3	17.6	27	14.3
	30 – 39	64	37.2	9	53.0	73	38.6
	40 – 49	32	18.6	4	23.5	36	19.0
	50- 59	25	14.5	1	5.9	26	13.8
	> 60	27	15.8	0	0	27	14.3
Gender	Males	124	72.1	17	100	141	74.6
	Females	48	27.9	0	0	48	25.4
Education	None	8	4.7	0	0	8	4.2
	Primary	30	17.4	0	0	30	15.9
	Secondary	38	22.1	0	0	38	20.1
	High school	56	32.6	0	0	56	29.6
	Tertiary	40	23.3	17	100	57	30.2
Experience	1 – 5	69	40.1	4	23.5	73	38.6
	6 – 10	28	16.3	7	41.2	35	18.5
	11 – 15	40	23.3	3	17.6	43	22.8
	16 – 20	14	8.1	2	11.8	16	8.5
	21 <	21	12.2	1	5.9	22	11.6
Marital Status	Married	151	87.8	13	76.5	164	86.8
	Single	21	12.2	4	23.5	25	13.2

Conclusively, results from the demographic variables indicate that most of the study respondents were middle aged, married males, educated with 1 – 5 years sugarcane production experience.

Reliability and accuracy of information sources

The third objective of the study aimed at determining reliable and accurate sources for sugarcane production information and the results are presented in Table 3. The results indicated that the Swaziland Sugar Association (97%) was perceived by respondents to be the main information source that always provides the most reliable and accurate information for the Swaziland sugarcane industry followed by the farmers themselves (76%), Input suppliers (71%) and financial institutions (61%). This implies that sugarcane farmers and extension officers have trust in information from these outlets. Researchers and other information generators can use these outlets to disseminate information that could assist sugarcane farmers improve their productivity. The library, University and NGOs were perceived as the worst outlets for reliable and accurate information source. Although the association is somewhat oblique, that the farmers show this level of discernment, these findings suggest that the farmers, in keeping with Ndoro (2011) are managing information as it relates to their farming operations.

Table 2: Reliable and accurate Information sources for sugarcane production

	Not at all		Rarely		Sometimes		Always	
	F	%	F	%	F	%	F	%
SSA	2	1.1	2	1.1	37	19.6	148	78.3
Farmers	11	5.8	33	17.5	97	51.3	48	25.4
University	91	48.1	77	40.7	16	8.5	5	2.6
SWADE	46	24.3	43	22.8	36	19	64	33.9
Government	73	38.6	49	25.9	43	22.8	24	12.7
Suppliers	20	10.6	33	17.5	86	45.5	50	26.5
Financiers	25	13.2	47	24.9	76	40.2	41	21.7
NGOs	89	47.1	66	34.9	28	14.8	6	3.2
Researcher	85	45	77	40.7	25	13.2	2	1.1
Library	126	66.7	44	23.3	14	7.4	5	2.6
Internet	97	51.3	36	19	29	15.3	27	14.3

Type of information and its degree of requirement

Objective two sought to identify the type of information that is required by the sugarcane industry as well as the level of requirement for such information as perceived by the respondents. Different types of information related to sugarcane production were presented and respondents were requested to rate their level of requirement for each type. Results are shown in Table 2. Results indicated that respondents perceived all the sugarcane production information as highly required. This perception of respondents indicates an existing information gap between what the farmers know versus what they need to know in almost all the sugarcane production activities. If this information gap could be effectively

addressed, smallholder sugarcane productivity could be improved. Contrary to the argument of Burton-Jones and Hubona (2006), the respondents appear to be very clear about what type of information they need and know what information is available. The results of the reliability and accuracy line of questioning confirm the value of strengthening linkages among the sugar industry players.

Table 3: Type of sugarcane production information and their level of requirement

	Not at all required		Less Required		Required		Highly Required	
	F	%	F	%	F	%	F	%
Land preparation	1	.5	2	1.1	7	3.7	179	94.7
Planting	2	1.1	6	3.2	0	0	181	95.8
Pest & disease control	0	0	2	1.1	10	5.3	177	93.7
Plant nutrition	0	0	2	1.1	6	3.2	181	95.8
Irrigation	0	0	2	1.1	5	2.6	182	96.3
Harvesting	0	0	2	1.1	7	3.7	180	95.2
Postharvest operations	0	0	2	1.1	10	5.3	177	93.7
Market Information	0	0	5	2.6	21	11.1	163	86.2
Financial Information	0	0	5	2.6	18	9.5	166	87.8
Human resource management	0	0	3	1.6	16	8.5	170	89.9
Technology Information	0	0	8	4.2	17	9.0	164	86.6
Economical information	0	0	5	2.6	15	7.9	169	89.4
Weather forecast	0	0	1	.5	11	5.8	177	93.7

Timeliness of relaying Information

Relaying accurate information at the right time for use by farmers is very crucial and has a huge impact on the productivity of a farmer (Meyer et al. (2011). Objective four of the study sought to determine which sources are perceived by the respondents to be very efficient in disseminating information at the right time. The results are presented in Table 4 and again the Swaziland Sugar Association (96.3%) came out to be the best source to relay information timely for use by smallholder farmers followed by farmers themselves (84.2%), Input suppliers (67.2%) and financial institutions (66.2%). These results suggest that the current arrangement in Swaziland meets the view of Meyer et al (2011) about the importance of correct and timely information to help smallholder sugarcane farmers with decision-making. These findings further suggest that although farmers perceive that information is relayed timeously, this could be through the use of ICT.

Table 4 Timeliness of sources to relay Sugarcane production information to other stakeholders

	Not at all		Rarely		Sometimes		Always	
	F	%	F	%	F	%	F	%
SSA	1	.5	6	3.2	24	12.7	158	83.6
Farmers	12	6.3	18	9.5	98	51.9	61	32.3
University	103	54.5	63	33.3	16	8.5	7	3.7
SWADE	49	25.9	41	21.7	35	18.5	64	33.9
Government	80	42.3	47	24.9	30	15.9	32	16.9
Suppliers	23	12.2	39	20.6	59	31.2	68	36
Financiers	27	14.3	36	19	66	34.9	60	31.7
NGOs	96	50.8	56	29.6	25	13.2	12	6.3
Researcher	103	54.5	56	29.6	22	11.6	8	4.2

Mode of information communication

The study also intended to determine the mode that is mostly used by the sugar industry to effectively circulate information among its stakeholders. The results are presented in Table 5 and they indicate that farmers and extension officers perceive cell phones (87.4%) to be the mostly used mode of communicating sugarcane production information followed by face to face (83.6%) and radio (53.9%). Respondents have confirmed that cell phone is the ideal technology that is currently in use to disseminate information within the sugar industry. This is also supported by the fact that almost all sugarcane farmers possess cell phones. This finding presents an ideal opportunity for the sugar industry extension service to introduce a formal communication system that uses mobile phones to facilitate information and knowledge exchange between smallholder farmers and other industry stakeholders. These findings are entirely consistent with the argument of Masuki et al. (2010) that one of the ways through which extension can reach a large number of farmers is to use ICT. The findings are inconclusive with regard to the impact on the costs associated with the way in which information is disseminated.

Table 5: Current means of communicating sugarcane production information to farmers

	Not at all		Rarely		Sometimes		Always	
	F	%	F	%	F	%	F	%
Radio	26	34.9	61	32.3	84	44.4	18	9.5
Television	66	34.9	71	37.6	46	24.3	6	3.2
Landline	147	77.8	9	4.8	18	9.5	15	7.9
Cell phone	14	7.4	10	5.3	43	22.8	122	64.6
News paper	37	19.6	82	43.4	56	29.6	14	7.4

Magazine	111	58.7	39	20.6	29	15.3	10	5.3
Fax	165	87.3	17	9	5	2.6	2	1.1
Internet	112	59.3	26	13.8	32	16.9	19	10.1
Face to face	28	14.8	3	1.6	34	18	124	65.6

Frequency of information exchange

Determining the frequency of information exchange between smallholder sugarcane farmers and the other sugar industry stakeholders is very crucial as it identifies those sectors that are effective in information exchange. Objective six of the study sought to determine this frequency. Respondents were asked to rate each sector and the results are presented in Table 6. Results show that smallholder sugarcane farmers exchange information more frequently with the Swaziland Sugar association extension agents (91%), followed by farmers (85.7%), extension agents from suppliers (81%) and extension agents from financial institutions (60.3%). This finding explains that information and knowledge is mainly exchanged among these four main sectors. These findings are consistent with the view that extension officers are a crucial connector between farmers and other actors in the dissemination of agricultural knowledge and information. They further suggest that the strength of this exchange would be enhanced through using ICT to access expert knowledge that can in turn be used to improve smallholder farmer's knowledge (Adebayo & Adesope, 2007; Omotayo & Adedoyin, 2005).

Table 6: Frequency of information exchange among the sugar industry stakeholders

	Not at all		Less frequently		Frequently		Most Frequently	
	F	%	F	%	F	%	F	%
Extension	2	1.1	15	7.9	39	20.6	133	70.4
Farmers	2	1.1	25	13.2	91	48.1	71	37.6
Suppliers	0	0	36	19	112	59.3	41	21.7
Financiers	5	2.6	70	37	80	42.3	34	18
Researchers	42	22.2	116	61.4	22	11.6	9	4.7
MTN	71	37.6	91	48.1	19	10.1	7	3.7

Discussion

The study has revealed that farmers and extension officers perceive the Swaziland Sugar Association followed by the farmers themselves as reliable and accurate sources of information for sugarcane production. The same observation was noted with regards to relaying information on time from the source to the end users. The frequency of information exchange was also found to be higher between farmers and the Swaziland Sugar Association. These findings however are not in line with McNamara (2009) who concluded that rural

smallholder farmers encounter a lot of challenges regarding accessing reliable and accurate information sources. He also noted that smallholder farmers encounter higher information costs, due to their isolation as well as the poor state of their ICT infrastructure resulting to a delay in relaying important sugarcane production information. In addition Meyer et al. (2011) noted that the absence of reliable and accurate information sources that can relay information on time to farmers was a major challenge for smallholder farmers yet it is one of the most valuable means for improving productivity among smallholder sugarcane farmers. With regards to the mode of communicating information among the industry stakeholders, the cellphone was rated high followed by face to face communication.

Farmers and extension officers perceived that all the sugarcane production information was highly required and this is an indication that they know what type of information they need and at what level, however, this finding is not in line with what Burton-Jones and Hubona (2006) discovered. They argued that most underdeveloped communities have farmers who are not aware of the type of information they need coupled with the level of requirement.

These results have indicated that the sugar industry of Swaziland is well coordinated by its mother body known as the Swaziland Sugar Association in as far as relaying accurate and reliable information on time among its stakeholders using the cellphone as the main mode of communicating information.

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Conclusion

From the findings of the study, it can be concluded that almost all the information on sugarcane production stages from land preparation to harvesting is perceived by farmers and extension officers to be highly required, which implies the need for relevant information as provided by the key actors in the industry. This observation indicates an existing gap on information availability among smallholder farmers for improved production. It is no doubt that sugarcane production information is available but the challenge is on disseminating that information to those remote and rural smallholder sugarcane farmers.

Regarding the reliability and accuracy of different sources that could provide such highly required information, the study identified the Swaziland Sugar Association to be the best source of sugarcane production information for the farmers and extension officers.

Relaying sugarcane production information to recipients on time is crucial as it enables farmers to implement accurate decisions at the right time hence improving their productivity.

The study also indicated that the most commonly used mode of communication as perceived by farmers and extension officers was the mobile phone, followed by face to face communication and the use of radio. The use of mobile phone among the Swaziland sugar industry stakeholders has increased with almost all of the respondents possessing and using them for sugarcane production information transfer. Almost all the sugarcane farmers revealed that they were using gadgets that they bought with their own personal savings. This is an indication that such a habit and attitude exhibited by the industry players towards this technology can be formally manipulated to improve information exchange within the industry.

The study has also shown that information exchange is most frequent between smallholder sugarcane farmers and the SSA extension officers followed by information exchange among the sugarcane farmers themselves then followed by input suppliers and financial institutions. Furthermore, and in the same order, these sectors were perceived to be the main sources that timely disseminates reliable and accurate information on sugarcane production.

Finally, the study [Chapters 6 & 7] also revealed that both sugarcane farmers and extension officers perceived themselves as ready for the introduction of this technology and the barriers associated with such a technology were not perceived as applicable to them. The clear implication is that the Swaziland's sugar industry players are ready for the introduction of ICTs to support them in growing sugar cane and producing sugar.

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CHAPTER 8: AN ICT BASED AGRICULTURAL EXTENSION SERVICE DELIVERY FOR THE SUGAR INDUSTRY OF SWAZILAND: A PROPOSED COMMUNICATION MODEL THAT ACCOMMODATES RURAL SMALLHOLDER SUGARCANE FARMERS

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Abstract

This paper proposes an ICT based extension service delivery system for the sugar industry of Swaziland. The proposed design is an improvement of the current system and it presents a delivery system that is void of many limitations inherent in the earlier approaches. This new model has been developed from findings of a survey study that investigated how information and knowledge is currently managed within the sugar industry of Swaziland. The study also sought to assess barriers and readiness of farmers and extension officers towards the use of ICT for information dissemination. Basically the model evolves around the use of mobile phones to timely relay crucial information among the sugar industry stakeholders in a more organised, productive and cost effective ways. Sugarcane stakeholders in the remote areas, can now be able to exchange information using the suggested model without having to meet physically; which is what most of the traditional approaches required. The exchange of information via mobile phones can be in a form of voiced communication, pre-recorded information in the form of texts, audio or audio visuals that can be utilised for training sugarcane stakeholders regarding sugarcane production processes. This would go a long way in enhancing smallholder farmer's productivity as it has the potential of empowering more rural sugarcane farmers with crucial information for improved decision making hence improving productivity. The proposed model has the potential to sustain itself once implemented effectively.

Key words: ICT, mobile phones, agricultural information, communication, sugar industry

Introduction

This article emanates from a study investigating the influence of extension services using Information Communication and Technology (ICTs) to improve the productivity of smallholder sugarcane farmers hence closing the productivity gap that exist between them and their large scale counterparts. Research conducted by Dlamini and Worth (Chapter 5, 6 & 7) identified that the Swaziland sugar industry is equipped with characteristics that supports the use of ICTs by the sugar industry stakeholders to improve the productivity of smallholder sugarcane farmers. The study discovered that these characteristics have not been fully manipulated for the benefit of smallholder farmers to improve their productivity. The findings of the study revealed that both extension agents and smallholder sugarcane farmers perceived themselves as ready for the implementation and subsequent use of ICTs to facilitate information dissemination among themselves. Furthermore, the study revealed that both farmers and extension agents perceived what was regarded as barriers to the use of ICTs for information flow as not barriers to them. Finally the study revealed the type of information that sugarcane farmers require as well as accurate and reliable sources that have the capability of relaying such information on time. The most efficient ways through which this information could be relayed were also identified.

Information and communication have always mattered in sugarcane production. Myer (2005) stated that information is a necessary resource with which problems are solved. Ever since human beings started growing sugarcane, they have exchanged information among themselves. Farmers in a given area may have produced a given crop for many years but with time as climate change kicks in, weather patterns and soil conditions change and the invasion of pests and diseases deviate from the norm, new information becomes the only solution for the farmers to adjust to such changes and even benefit from these changes. Developing better ways of farming such as the introduction of new varieties which perform much better than the original ones are some of the available options brought about by updated or new information. Providing updated knowledge to smallholder farmers, especially those located in the remote poor areas can be challenging however the introduction of Information Communication Technologies (ICTs) has made such a challenging task manageable. For the smallholder sugarcane producer to improve production, new information that is accurate, reliable and presented timely is very crucial.

Omotayo and Adedoyin (2005) observed that farmers in developing countries are slow in recognizing the importance of information as well as the use of ICT to acquire knowledge, instead they have over relied on the use of extension agents. According to Van den Ban (2006), extension agents may be the most effective sources for farmers but obviously not the most efficient as evidenced by huge costs, extent of coverage and time.

Christoplos (2010, p. 3) defines extension as "systems that facilitates the access of farmers, the organisation and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions; and assist them to develop their own technical, organisational and management skills and practices". This definition presents extension as responsible for facilitating farmer's access to information, knowledge and technology as well as developing their own skills and practices. These functions of extension can be efficiently executed by extension services personnel through the use of relevant ICTs well supported by the environment in which they operate.

Omotayo and Adedoyin (2005) observed that agricultural extension relies mainly on information dissemination amongst farmers and other stakeholders within the field of agriculture. Extension agents, therefore, who are the direct connectors on the ground between farmers and other stakeholders in the agricultural knowledge and information system (AKIS) must be alert and utilise ICT to access advanced knowledge and information that will improve their productivity.

The extension strategy of the Swaziland sugar industry aims at improving yields and ensure sustainability through providing technology transfer and advisory services to sugarcane growers on all aspects of sugarcane production. This include provision of advice about research findings to smallholder sugarcane growers and adoption of improved agricultural practises for increased productivity, profitability and sustainability (SSA, 2014/2015). The report goes on to state that these will be attained through the short and medium perspectives of the strategy which include: the capacitation of extension officers to provide farm business management skills to the smallholder farmers; provision of a holistic extension service to growers and the continuous improvement in sucrose yield. The overall long term perspective of extension according to the report aims at moving extension from supply driven (Scheduled) to demand (On request) driven extension. SSA expects that eighty percent of the smallholder sugarcane farmers must be able to make sound business

management decisions within ten years of the strategy implementation. The introduction and subsequent use of ICTs by the sugarcane extension personnel and smallholder farmers could be an ideal vehicle that will enable this strategy to be implemented efficiently and within the time frame that has been set. Salau, Saingbe, and Garba (2013) submitted that the time is now for the adoption of ICT by every stakeholder in agriculture so as to exchange relevant information in a more efficient way.

Debates have ensured on how ICT can assist in reducing poverty in developing nations (Heek, 1999). Samiullah and Rao (2003) noted that if ICTs are effectively implemented, they have the capacity to reduce poverty and enhance sustainable development. This paper proposes a model that will use ICT in Swaziland to strengthen sugarcane extension services such that the barriers presented by the long distances between extension officers and famers for a physical encounter can be effectively cut down such that sugarcane farmers in the furthest and remote rural areas can exchange information with any sugar industry stakeholder, thereby minimising the extra cost of travelling. This will also address the challenge of top to bottom nature of earlier approaches where information was flowing in one direction. With the suggested model, sugarcane farmers can originate queries, and get immediate response via mobile phones while within their work stations.

The current sugarcane extension communication model

A range of institutions are responsible for the provision of advisory services and training to the sugarcane growers of Swaziland. These institutions include Swaziland Sugar Association (SSA), Swaziland Water and Agricultural Development Enterprise (SWADE), Financiers, input suppliers and Government. Most of the communication with farmers around sugarcane production occurs through one or more of these institutions. Figure 1 depicts the current operational model in which sugarcane extension personnel is currently expected to relay information and knowledge between information generators and smallholder sugarcane farmers in Swaziland. Currently the process is completely manual. Extension officers are the ones who have the closest contact with the farmers. Most of the information they keep is on paper and maintained by each extension officer. This information is then translated to monthly reports that are submitted to the different extension mangers within the industry before they are included in the annual report (SSA, 2014/2015; SSA, 2014/2015). The process obviously suffer from severe paper based issues such as duplication, redundancy or

in case of diary being lost, there is a need to recapture the information from scratch. Each extension service provider (Finance, suppliers, SSA, Government) compiles its annual report that is independent of the other.

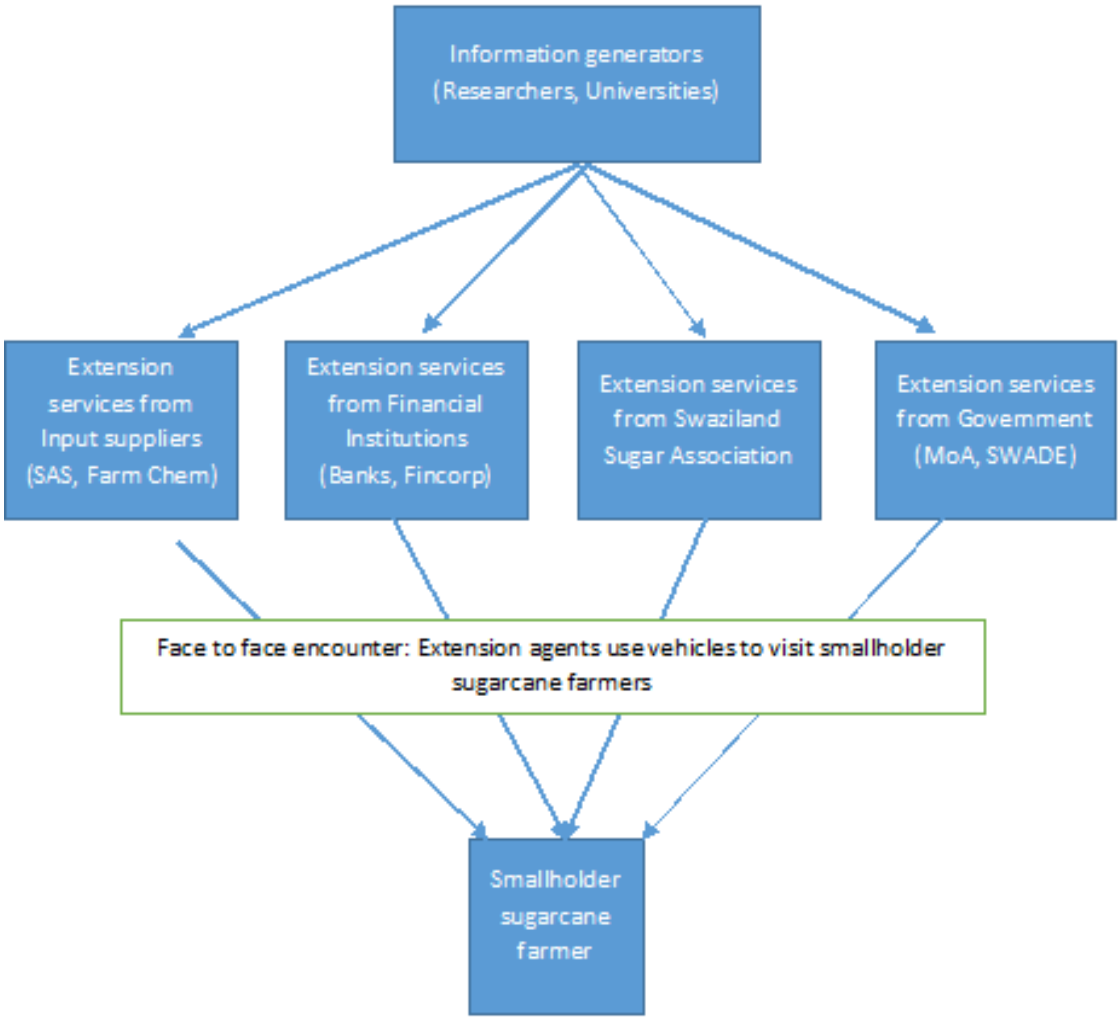

Figure 1: Current model for the sugar industry extension to deliver sugarcane production information to smallholder sugarcane farmers

Figure 1 shows that information and knowledge is disseminated through mainly the face to face method. Extension Agents are given vehicles and they travel from one sugarcane farmer to the next to disseminate or collect information related to sugarcane production following a pre- determined schedule. Currently there is no system that supports an extension service delivery which coordinates the three domains which are; Telecommunication,

extension and Research for improved information dissemination thereby increasing the productivity of smallholder farmers.

Challenges of the existing extension system

The method of communication depicted in Figure 1 has a lot of challenges for both smallholder sugarcane farmers and extension officers. It is less demand-driven in that officers cannot give guidance to farmers as and when it is needed. Extension workers also do not reside with farmers within the community which reduces the frequency of information exchange among these stakeholders. On the other hand, extension services provided by governments are not effective due to inadequate funding. Diamond (1992) noted that the quality of extension in Swaziland is plagued by many factors; the major problems center on lack of clearly defined technical messages to be disseminated to the majority of farmers. Oladele et al. (2009: 317-318) found that the key strengths of Swaziland's extension service were that it had improved its extension systems and method, extension plans were highly feasible, and the setting of extension administration units was effective. The same study found that the greatest weaknesses of Swaziland's extension service were over-centralization of the budget for extension work and insufficient manpower.

More broadly, Keregero (2000: 79) found that Swaziland's extension service was not contributing to any significant improvement in the livelihoods of farmers. The key cause of this were "a of lack of a clearly defined philosophy, often leading to the use of top-down, directive methods; the extension job being male dominated and gender stereotyping; and most of the frontline extension workers being youthful, moderately experienced in their job and relatively lowly qualified". With specific reference to communication institutions mandated to disseminate information were not trusted by farmers. Communication was further hampered by insufficient extension personnel "leading to inequitable and infrequent coverage" (Keregero, 2000:79).

Most of the smallholder sugarcane farmers are sparsely located in the remote rural areas. Extension agents have to travel long distances to reach them thereby attracting high travelling costs on fuel. Accessibility is a challenge due to poorly constructed roads which become

worse during the rainy season. The frequency of visit to such areas by the extension agent is reduced by such factors thus depriving the farmer of crucial information. Farmers do not receive information on time and this results to poor decisions being taken out of ignorance which ultimately leads to poor yields. These poor and remote smallholder farmers have minimum sources where they can obtain information as and when they need it (Diamond, 1992).

Eweg (2005) also observed that some smallholder sugarcane farmers are circumstantial farmers. These are farmers who joined the sugarcane production business not because they had the passion for the business but because they found themselves within the development project area where sugarcane needed to be grown. Therefore, Eweg (2005) noted that this kind of farmer needs a lot of extension support and motivation to be convinced that the sugarcane production business is viable. It becomes therefore difficult for such farmers to perform efficiently under this type of extension model.

The proposed refurbished sugarcane extension communication model

The suggested model is a result of the study findings and it fits well to the country's telecom infrastructure. It aims at addressing the problems of converting extension information into digital form while at the same time allowing marginalised smallholder sugarcane farmers to have timely access to accurate information.

The model presented in Figure 2 is a refurbished sugarcane extension communication model that aims at facilitating better communication between sugarcane farmers, information generators and extension officers. This model identifies three elements to refurbish the existing model in order to improve information dissemination among the sugar industry stakeholders via ICTs. The model proposes that there should be a telecentre administered by SSA in conjunction with MTN to coordinate all information between the different extension service providers and smallholder sugarcane growers.

Also proposed is that every stakeholder especially smallholder farmers and extension officers should possess mobile phones for receiving and sending sugarcane production information to and from themselves and other stakeholders, which is the case with the entire Swaziland sugar industry as indicated in Chapter 7. This will ensure that technical messages are relayed timely and effectively between famers and extension officers. Finally, the model

requires sufficient network coverage in all the areas where sugarcane is grown to enable the use of mobile phones for information circulation. Again, the study found that almost every sugarcane growing area in Swaziland is covered with the mobile network at different strengths though. This will enable every farmer to have unlimited access to information disseminated via ICT.

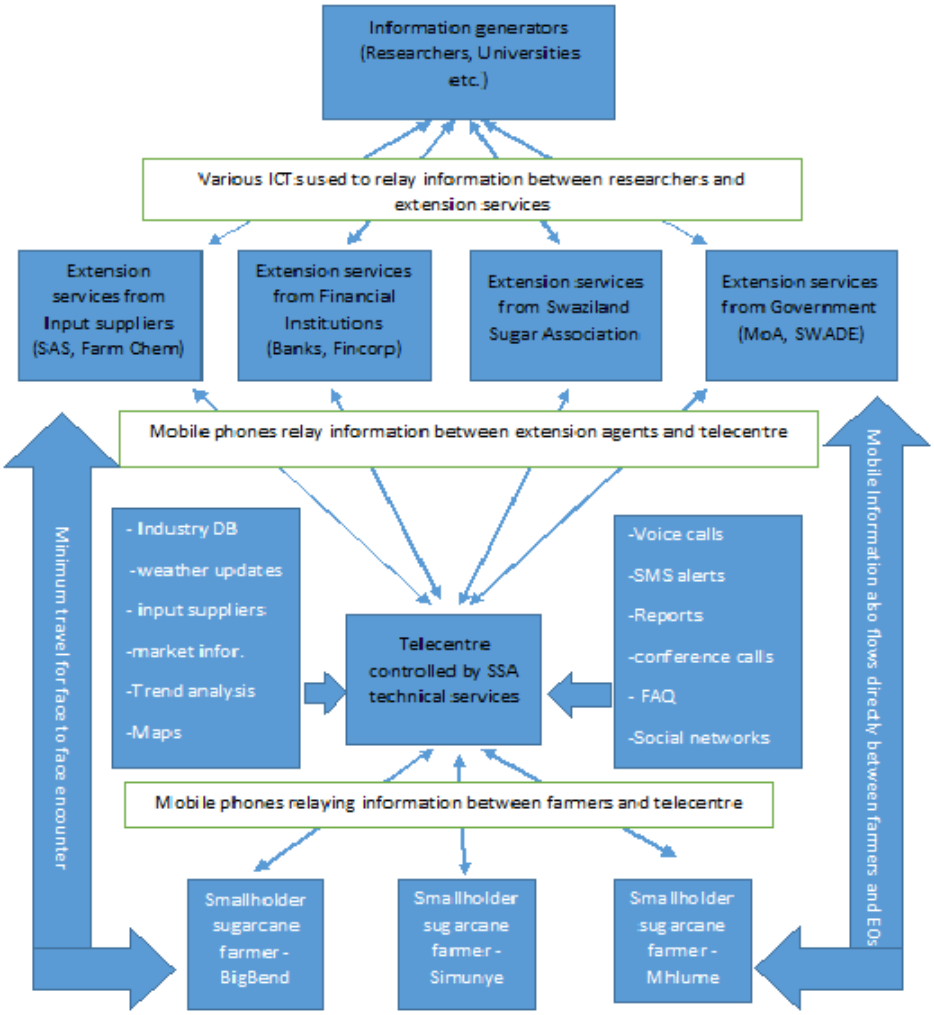

Figure 2: A refurbished model for the sugar industry extension to deliver sugarcane production information to smallholder sugarcane farmers

The interaction between rural farmers and extension officers via ICT within the tele-centre will be enhanced since there will always be people in the telecentre who will facilitate the exchange of information thus giving both farmers and extension officers unlimited access to vital information.

The main components of the model consists of firstly the user base which are the sugarcane farmers, extension officers and institutional users. The second component is the user interface which consists of the mobile applications for farmers and extension officers as well as the web based interface for institutional users. This refurbished model suggest creating an extension system that allows accurate and reliable information to be circulated timely via mobile phones among the industry stakeholders enabling everyone to possess adequate and up to date information for making accurate decisions on time. This will in turn escalate to improved sugarcane productivity especially among smallholder farmers.

Mobile phones

Despite their new entrance into remote agricultural communities, mobile phones are already assisting smallholder farmers in the rural remote areas to improve their agricultural activities. Advances throughout the mobile phone ecosystem has presented numerous advantages to smallholder sugarcane farmers which include:

- Access – most rural and remote areas of developing countries are experiencing an increase in mobile wireless networks and the number of people using mobile phones is on the increase;

- Affordability – the availability of affordable gadgets has made it possible for even rural smallholder farmers to own second hand mobile phones and use it to exchange information; and

- Applications – the available applications and services found in mobile phones start from simple text messaging services to increasingly advanced software applications. This applications allows even the less skilled person in terms of operating the gadgets to be able to benefit from them. Making/receiving a call and sending text messages are some of the applications that are simple to operate.

The most common way through which mobile phones can enhance sugarcane production is through facilitating farmer exposure to less costly information. Where sugarcane production areas are remote with inaccessible roads, substituting phone calls for travel reduces time and cost burden for every sugar industry stakeholder. Sugarcane farmers who utilise mobile phones do save on travelling costs (Overå, 2006) and this effect is more real to those farmers that are in remote areas (Muto & Yamano, 2009). It is not possible

however, to completely avoid transport because extension officers do need to physically visit the farmers in field for real assessments and demonstrations.

Mobile phones are multifunctional devices ranging from regular phones to smart phones. Mobile phones do much more than simply placing a voice call. Table 1 summarises the various types of mobile technologies and their availability.

Table 1 Types and Availability of Mobile Technology

TECHNOLOGY	DESCRIPTION	AVAILABILITY
Voice	The most basic channel; avoids most literacy or linguistic barriers	Basic phones
Short Message Service (SMS)	Ubiquitous text-based message limited to 160 characters	Basic phones
Unstructured Supplementary Service Data (USSD)	A protocol used by Global service for mobile communications (GSM) phone to communicate with the mobile network.	Basic phone
Interactive Voice Response	Computer programs that respond to the voice input of callers	Basic phones
General Packet Radio Services (GPRS)	Low bandwidth data service	Mid-range phones
Software App (e.g. Java or iOS)	Preinstalled or downloaded software of varied sophistication	Smartphones
Mobile wireless Application Protocol (WAP)	A limited manner of browsing the internet	Mid-range phone
Multimedia Messaging Service (MMS)	SMS-based technology to transmit multimedia (Including images and video)	Mid-range phone
Camera	For capturing still or moving pictures	Mid-range phone
Bluetooth	Protocol for transmitting data over short distances	Mid-range phone
Mobile web	Full-fledged web access	Smart phones
Global Positioning System (GPS)	Technology allowing for location-based information	Smart phones

Source: https://www.crisscrossed.net/2009/11/01/the-many-potential-channels-for-mobile-services/

The capabilities of mobile phones are improving on a daily basis and information channels are converging. Smart phones and software applications provide advanced functionality such as conference calls, video conferencing, social media, GPS for mapping functionality, mobile money applications etc. Extension can now access many clients within a short space of time through mobile based learning platforms such as texts, pictures, videos etc. which provide information to sugarcane farmers on how to improve their sugarcane production skills and knowledge.

The Information and communication Centre

This is the main engine of the model and it consists of the technology centre, Infrastructure management, Knowledge management, helpline and the panel of experts.

The technology centre is where information is given to farmers/extension officers via mobile phones. The information may vary from general issues regarding sugarcane production to more specific issues such as weather updates, control of sugarcane pests and diseases, market environment etc. The study has revealed that sugarcane farmers are heavy users of regular phones manufactured by Nokia and Samsung.

Another application will be that of collecting information from field for institutional users using mobile phones. This will ensure an efficient and accurate data collection process that will yield timely reports. This is also where there is infrastructure management which involves the management of information exchange links (Internet and Phone).

The main objective of knowledge management is to produce meaningful information from the operational data and get useful results from it through providing more personalised, client oriented and crucial information forwarded straight to the famer's handsets. The knowledge generated will be for researchers, research users and policy makers. Help line will operate like a call centre and it will address sugarcane production problems that cannot be solved via mobile applications. For issues that cannot be answered by the helpline staff, the call will be re-directed to a conference call where an expert in the field will be asked to shed some light. This is where frequently Asked Questions (FAQ) database will be updated

Panel of experts in sugarcane production is proposed that will support the helpline staff. These will be knowledgeable extension officers already working in the field who will work as consultants for the helpline. Queries not addressed by the helpline will be forwarded to the appropriate research institutions.

Specifically, the model aims at achieving the following

- Provision of accurate, reliable and timely usable information among the sugar industry stakeholders. The information will be about mainly the information needs of smallholder sugarcane farmers as identified by Dlamini and Worth (Chapter 7). Such information will be distributed through mobile applications.

- Disseminating information in local language. This is easier for Swaziland as one national language is used and understood by every citizen of the country.
- Delivering voice based content to the sugar industry stakeholders thus overcoming literacy barriers.
- Establishing a helpline backed by experts in the sugarcane growing field and providing advice within the shortest time possible.
- Improving agricultural extension by using specialized applications on mobile phones such as those applications that can aid in data collections for surveys conducted by research institutions.
- Creating a solid financial and technological base in terms of content.

The project impact

The project will ensure a fair access to information by sugarcane growers especially smallholder farmers. This will improve the ability of farmers to make accurate and informed decisions thus improving their productivity. The process of collecting data using mobile phones will lower infrastructure costs, remove transportation costs, increase accuracy and also help in the monitoring of field staff. The project output will have an influence towards policy making and enhance the working standards of extension officers.

Opportunities offered by the proposed design.

The proposed design has the ability to assist the sugar industry stakeholders have access to up-to-date information and guidance from different reliable sources. These sources may include extension officers, other farmers and agricultural database websites to mention a few. Requests are forwarded to the information communication centre where appropriate responses are generated by relevant researchers. This approach is different from the traditional one (Overå, 2006) where all queries are managed by one agricultural expert.

Unlimited exposure to information - Another interesting aspect of this model is its ability to stimulate farmer driven extension where by farmers initiate request for guidance and assistance based on their unique needs. This model also ensures that farmers get real time

response on their requests, they do not wait for extended periods to submit their request when the extension officer visits them. The demands can be made almost immediately when there is need for it (Overå, 2006).

Cost effectiveness – The suggested model is also cost effective and these costs can be distributed to all the industry stakeholders so that it is shared equally. This will make even smallholder sugarcane farmers be able to contribute towards this project. The design is also self-sustainable as all the services it provides could be charged at a minimum fee. Donor agencies are also willing to finance projects that are aimed at improving the productivity of smallholder rural farmers.

Challenges

This part of the study, highlights some of the challenges of the model and discuss how their effects could be minimized.

Illiteracy - Illiteracy has always been a challenge when it comes to technology adoption. This is especially very true when the technology has to do with information exchange. For instance, people who use their mobile phones for voice communication are more than those who use the mobile phones for text messaging functionality. New applications have been put in place that have the capacity to recognise voices. These applications are ideal for the illiterate population so that they can have access to information on "voice sites" (and not websites) in audio format.

Power supply requirement - All ICT tools need electricity to operate. However, as observed earlier in this study, Swaziland has embarked on a project of rural electrification which has seen the entire sugar belt receiving a complete coverage. This however could be supplemented by the use of solar panels during the day.

Funding - The funding needed for this suggested model can be in two parts; the establishment cost and the maintenance costs. These could be provided by a collaboration of the Swaziland Cane Growers Association (SCGA), Swaziland Millers Association, sponsors and the government of Swaziland.

Conclusions and recommendations

Countries all over the world are engaged in national development and this objective is recommendable because people's lives are ultimately enhanced. For any country to achieve this objective, it must start this development at grass roots by first engaging agriculture and rural development. One of the first important steps towards this idea is the development of personnel via the use of ideal mass media channels. It is important to maintain a good balance in the dissemination and targeting of information among the sugar industry stakeholders so as to harness the full potential of our rural populace towards attaining national development.

Farming in a sustainable manner is both knowledge intensive (Garforth & Lawrence, 1997) and information demanding compared to conventional methods, because skills effectively takes the space of external inputs (Garforth & Lawrence, 1997; Pretty, 1995). In essence, the roles of knowledge, information, technologies, skill and attitudes in sustainable agriculture cannot be overstated and sustainable farming would necessarily be best supported by extension through implementing programmes aimed at building capacity among farmers.

The proposed model must be adopted if we sincerely require a strong and healthy agricultural extension delivery system in the sugar industry of Swaziland.

This model will no doubt assist the extension workers access more farmers in a cost effective way. To achieve this, the following recommendations are made;

1. This model needs to be continuously evaluated and fine-tuned for improvement
2. All the sugar industry stakeholders, especially the smallholder farmers should be informed about the benefits of the model.
3. Pilot sites should be established in various locations of the country (e.g. in the three sugar mills of the country) to assess its effectiveness.
4. Recommendations for continuous improvement must be made based on the results of the pilots in 3 above.
5. The search for sponsorship should be undertaken where potential donors and government agencies should be requested to finance the project.

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CHAPTER 9: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the overall account of the study. The research conducted explored and addressed the question: How best can the Swaziland extension service employ ICT, especially mobile phones, to reduce the persisting productivity gap that exists between smallholder and large-scale sugarcane growers? The specific objectives addressed in this study were to:

5) Determine the readiness of smallholder sugarcane farmers and extension officers towards the use of ICT to access timely, accurate and up-to-date sugarcane production information;

6) Identify the barriers towards the use of ICT by farmers and extension officers to access information and knowledge for improved sugarcane productivity;

7) Describe information and knowledge management as it occurs among sugarcane farmers and extension officers for improved productivity.

8) Propose a model for improving information and knowledge access among Swaziland's smallholder sugarcane farmers and extension officers for improved sugarcane production.

Through this investigation, it is hoped that the insights gained will help to enable the work of extension practitioners and other sugarcane production programmes improve productivity of smallholder sugarcane farmers through better more, reliable information access. It is further hoped that through this study, extension agencies will have a clearer understanding of how they can organise and implement their extension programmes and engage with farmers to promote their access to accurate, timely and up-to-date information via ICT.

The conclusions presented in this Chapter are drawn from the findings presented in Chapter 5, 6, 7 and 8. These conclusions are presented under the headings of the study objectives above.

Readiness of smallholder sugarcane farmers and extension officers

Cell phones have a huge potential to change the manner in which information knowledge and new technology is used, improved and disseminated to farmers. Smallholder sugarcane farmers need help from various sources to adopt knowledge and information. In this regard, extension officers were identified as the most effective intermediaries for delivering information and knowledge to sugarcane famers. Therefore, assessment of readiness of both farmers and extension officers towards the use of cell phones as communication technology is very crucial.

The results revealed that sugarcane farmers and extension officers perceive the Swaziland sugar industry to be ready for the introduction and subsequent use of ICTs to access sugarcane production information. The sugar industry infrastructure and other facilities that are necessary for the use of cell phones were perceived to be ready for the implementation of the cell phone technology. All respondents were also found to possess cell phones which they personally owned. The entire sugar industry had access to cellular network and electricity.

With regard to the minimum requirements to justify mobile communication facilities within the Swaziland sugar industry, the study demonstrated a high readiness level as perceived by the respondents. All farmers and extension officers reported to have access to both network and electricity in almost all their respective areas where they grow their sugarcane, which is crucial in the implementation of the cell phone technology for information dissemination. They all also reported that they personally owned cell phones which they already use to disseminate and access information during and outside extension officers' working hours. However, most farmers are using simple models of cell phones which have less functions than smartphones. This may limit the farmers when it comes to accessing information on the Internet or in the form of videos or pictures. Given the increasing use of "Apps", the farmers will soon find themselves at a disadvantage. Further, while farmers do use cell phones to access farming information, they still do a lot of travelling by foot when conducting their routine farming business. The use of cell phone

technology, again, particularly smartphones, can reduce this challenge. Therefore, there is a need to train these farmers to upgrade their instruments to smart phones.

Based on these findings, the sugar industry of Swaziland can confidently expand the use of mobile cellular technology to improve information access among its sugarcane production stakeholders, especially smallholder farmers. This could be through ensuring that every smallholder sugarcane farmer is provided with, or otherwise has access to a smartphone and taught how to use it. To facilitate connection to and use of more sophisticated information platforms, they could also be provided with a minimum airtime and data bundle allowance. The overall cost of these could be deducted from the proceeds of their harvest, as is done with other production inputs. Another opportunity that exists is that of negotiating for a group treatment of the sugarcane farmers from the mobile service provider where benefits of special rates and the ability to send group information to farmers could be discussed.

Barriers towards the use of ICT by farmers and extension officers to access information and knowledge for improved sugarcane productivity

Knowing what barriers farmers and extension officers face to access sugarcane production information via ICT will assist in designing a information system that will enable smallholder farmers to meet their information needs in Swaziland. Of course, access will encourage smallholder farmers to adopt the information, and to do so in good time, thus improving their productivity. Using a constructed conceptual framework, the study specifically sought to identify the extent to which information, organisation, human resource, technology and policy barriers were actually barriers to access the information they required via ICT.

The results of the study revealed that sugarcane farmers do not perceive any of these barriers to be a hindrance to information access via ICT. However, extension officers differed regarding some of these barriers – specifically, they felt organisation and information barriers did inhibit access to information via ICT.

The study also aimed at identifying demographic variables that had an influence to respondent's perceptions of the barriers towards the use of ICTs for information access by the sugar industry. Results indicated that gender, education level and respondent's job category were found to have a significant influence on the perceptions of respondents. This implies

that demographic variables must be considered when planning the use of ICTs especially cell phones to access sugarcane production information.

Information and knowledge management among sugarcane farmers and extension officers for improved productivity

Effective knowledge management is received when the right knowledge and information is disseminated to the right farmers at the correct time in an accessible manner that assists farmers to execute their responsibilities efficiently and the results of this is improved productivity and performance of the agricultural sector (Faisal, 2010). The study investigated how information and knowledge is managed through the use of ICTs, specifically cell phones, by smallholder sugarcane farmers and extension officers within the sugar industry of Swaziland. The study specifically found that farmers and extension officers considered almost all the information on sugarcane production stages, from land preparation to harvesting, to be highly required by them. This implies that smallholder farmers perceive that they themselves lack critical information relevant to their sugarcane production. This observation indicates an existing gap on information availability among smallholder farmers for improved production. It is no doubt that sugarcane production information is available but the challenge is on disseminating that information to those remote and rural smallholder sugarcane farmers. Regarding the reliability and accuracy of different sources that could provide such highly required information, the study identified the Swaziland Sugar Association to be the best source of sugarcane production information for the farmers, followed by the farmers themselves, input suppliers and financial institutions. These four sources were also perceived in the same order by farmers and extension officers to relay sugarcane production information to recipients on time and this is crucial as it enables farmers to implement accurate decisions at the right time hence improving their productivity.

The study also indicated that the most commonly used mode of communication as perceived by farmers and extension officers was the mobile phone, followed by face to face communication and the use of radio. The use of mobile phone among the Swaziland sugar industry stakeholders has increased with almost all of them possessing and using them for sugarcane production information transfer. Almost all the sugarcane farmers revealed that they were using gadgets that they bought with their own personal savings. This is an indication that such a habit and attitude exhibited by the industry players towards this

technology can be formally manipulated to improve information exchange within the industry.

In the previous two chapters (Chapter 6 & 7), the study also revealed that both sugarcane farmers and extension officers perceived themselves ready for the introduction of this technology and the barriers associated with such a technology were not perceived as applicable to them. This study findings imply that the sugar industry players are ready for the introduction of such a technology. The study has also shown that information exchange is most frequent between smallholder sugarcane farmers and the SSA extension officers followed by information exchange among the sugarcane farmers themselves then followed by input suppliers and financial institutions. Furthermore and in the same order these sectors were perceived to be the main sources that timely disseminates reliable and accurate information on sugarcane production.

Proposed model for improving information and knowledge access among Swaziland smallholder sugarcane farmers and extension officers for improved sugarcane production

Farming in a sustainable manner is both knowledge intensive and information intensive (Garforth & Lawrence, 1997; Pretty, 1995). The roles of knowledge, information, technologies, skill and attitudes in sustainable agriculture cannot be overstated. Based on the findings of this study sustainable farming is best supported by extension through implementing programmes aimed at building capacity among farmers.

For the sugar industry of Swaziland, an extension delivery system that uses the Internet for the distribution of information and knowledge among the sugar industry stakeholders, is the best approach for improved productivity especially among the remote rural smallholder famers. This approach is particularly relevant now as ICT is becoming more commonplace and, in some ways, essential to any institutions engaged in information gathering and dissemination and in communication – as is the case with agricultural extension. To give direction to this, a model is proposed to promote the establishment of a strong and healthy agricultural extension delivery system in the sugar industry of Swaziland.

This model is designed to assist extension workers access more farmers in a cost effective way. To achieve this, the following recommendations are made:

1) There has to be a shift among extension service providers from the top-down approach system to a knowledge sharing and facilitated learning approach. Sugarcane farmers must be treated by their extension workers as partners in developing new skills rather than viewing farmers as merely recipients of scientifically generated information. Such an arrangement will enable farmers to be involved in the identification of real challenges that they face on the ground and be able to engage other actors at the earliest convenient time possible for assistance. The use of ICT, such as the mobile cellular, could promote full participation of the farmers in providing a quick solution to an existing challenge. Such an arrangement will also lead to a set of farmers that will take command of their individual and collective production, agribusiness and related challenges, in terms of identifying them, surveying the resources at their disposal and generating local adaptive and creative solutions to them.

2) The use of ICT by both extension workers and sugarcane farmers to access information, coupled with the shift to collaborative learning, should help further reduce the dependency of farmers on extension workers for information and knowledge. Through the use ICT, farmers should be able to source timely, accurate and up to date information from various sources on their own and, where necessary, with the assistance of extension workers. Information accessed through ICT would embrace the full spectrum of issues related to sugarcane production, including technology choices (equipment and processes), marketing, finance, input supply, infrastructure and managing the information itself.

3) The use ICT by the sugar industry actors should promote social capital among farming households. This will enhance the capacity of farmers to manage their farming operations more effectively and efficiently. Farmers will be able to share information with one another via ICT as and when the need arises. It will improve the utilisation and effectiveness of socio-cultural safety nets inherent in rural communities. It will also improve organisational bargaining strength among the farming communities, strengthen their command over the factors that influence their lives.

Implications of the study

The study has revealed that the sugar industry of Swaziland is currently at an advanced level of technology readiness. Literature indicated that, on average, smallholder sugarcane farmers in the rural areas of developing countries are still finding it difficult to obtain crucial sugarcane production information via the use of ICT. However, this study has revealed the opposite for the smallholder sugarcane farmer in the rural areas of Swaziland. Almost all the smallholder farmers were found to be ready for the use of ICT, specifically cell phones, to access and exchange on time crucial sugarcane production information so as to improve their productivity. What literature viewed as barriers that inhibit the use of ICT by smallholder farmers, were perceived by smallholder farmers in the sugar industry of Swaziland as not applicable in their context.

The study further indicated that smallholder farmers frequently use their mobile phones to relay information via voice calls. The Swaziland Sugar Association emerged as the main source of production information and capable of relaying information on time and that the highest frequency of communication within the sugar industry is between farmers and extension officers. Visits between the two are most frequently initiated the farmers.

These results imply that smallholder farmers in the sugar industry of Swaziland are more than ready for the introduction of ICTs, for improving information access among themselves. Therefore, the Swaziland Sugar Association, in its quest to improve sugarcane productivity among smallholder farmers, would do well to capitalize on this readiness and facilitate an organised system of information exchange among the industry stake holders using ICTs. The proposed model from this research could assist in realising this.

Recommendations for further study

This research had a number of limitations which open the way for further research in the area. The study was carried out in only one region of Swaziland, and it focused on a single commercial crop – sugarcane. It is likely that the issues researched in this study are also relevant to other crops grown in Swaziland.

While the research facilitated gaining more comprehension of the readiness, information management and perceived barriers towards information access via ICT, it is not possible to generalise the outcome of the study to other samples. Different areas have diverse attributes with regards to infrastructure and management. Therefore, more research should be carried out in various parts of Swaziland and in other developing countries to achieve a more conclusive and generalizable results.

The study evaluated readiness at the initial stage of ICT programme application; hence a need to execute further research to evaluate readiness and hindrances of ICT programmes later after its application to give greater dependability to the study outcomes in this area.

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APPENDICES

Appendix 1: Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

9 March 2016

Mr Mbuyazwe Michael Dlamini 214584240
School of Agricultural, Earth and Environmental Sciences
Pietermaritzburg Campus

Dear Mr Dlamini

Protocol reference number: HSS/0186/016D
Project Title: Towards reducing sugarcane productivity gap between large-scale and small - scale farmers: Influence of ICT among Sugarcane Growers in Swaziland

Full Approval – Expedited Application

In response to your application received 25 February 2016, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

Dr Shenuka Singh (Chair)
Humanitities & Social Scinces Research Ethics Committee

/pm

Cc Supervisor: Professor S Worth
Cc Academic Leader Research: Prof Onisimo Mutanga
Cc School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
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Website: www.ukzn.ac.za

Appendix 2: Letter and Form of Consent

UNIVERSITY OF KWAZULU-NATAL

Agricultural Extension and Rural Resource Management

Ref: Mbuyazwe Dlamini

Dear Experts,

LETTER AND FORM OF CONSENT

I am a PhD student in the Department of Agricultural Extension and Rural Resource Management at the University of KwaZulu-Natal, Pietermaritzburg Campus. I invite you to participate in a study I am conducting titled "Towards reducing sugarcane productivity gap between large-scale and smallholder farmers: influence of ICT among sugarcane growers in Swaziland."

Gathering information on all the aspects of enclosed interview questions will help me understand the perceptions and the current position of farmers and extension officers relative to information communication and technology within the sugarcane industry in Swaziland. The findings of the study will be used to develop a communication model that will assist the sugar industry stake holders to exchange information hence improving their productivity.

Your participation is voluntary; and your identity and information provided will be kept strictly confidential. The data provided by you will be combined and analysed with those from other participants, and the findings will be reported in a summary form such that individual responses are not identified.

I anticipate that the completion of the interview will take about 45 – 50 minutes of your time. If you agree to participate, please complete and sign the consent form attached.

For further information, you are free to send me an email at: 214584240@ukzn.ac.za or call me on: +27603089064 (SA) or +26876045909 (SD).

Thank you in advance for your assistance and cooperation. The success of the study depends greatly on your cooperation and generous responses to the questions.

Yours Sincerely,

Mbuyazwe Michael Dlamini

DECLARATION I……
(Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT DATE

…… ……

Appendix 3: Letter requesting permission for assistance.

UNIVERSITY OF KWAZULU-NATAL

Agricultural Extension and Rural Resource Management

Ref: Mbuyazwe Dlamini

Date: ……

…….

…….

Mr Mbuyazwe Michael Dlamini: Student number 214584240

Dear Colleage

This letter serves to confirm that the above named student is currently conducting research under the guidance of our unit in pursuit of his Doctorate. His area of research is Agricultural extension. Specifically he is looking at the role of ICT in facilitating the flow of information among sugarcane stakeholders with an aim of improving the productivity gap between small and large scale sugarcane growers in Swaziland.

To complete his research Mr Mbuyazwe Dlamini will be conducting interviews with extension workers and smallholder farmers involved in the business of sugarcane growing in Swaziland. Others to be interviewed are representatives of the Ministry of Information, communication and Technology as well as the mobile network provider in Swaziland. In addition he will be reviewing reports and reviews published by government and research institutions.

We kindly request that you assist him in any way possible. Particularly by allowing him to have access to staff, managers and relevant documents over which you may have responsibility. All his research is subject to the highest ethical standards as withheld by the University of KwaZulu-Natal.

Should you have any questions or queries, please contact me at your earliest convenience.

Thank you very much for your cooperation.

Steve Worth (PhD)
Senior Lecturer
Programme coordinator
Agricultural extension and Rural Resource Management.

Appendix 4: Questionnare for Sugarcane Farmers

1. Name of Farm…… 2. Date of interview…….

2. Name of Respondent……

3. What is your current position?

Chairman	Manager	Assistant	Other

4. Farm size……Ha

5. Farm Location……

6. Distance from mill……KM

7. Milling Area:

Mhlume	Simunye	BigBend

7. Language:

English	Siswati	Both

8. Average Yield for last season…….tons/ha

9. Age of respondent……..Years

10. Gender……

11. Nationality……..

12. Sugarcane production experience……..yrs

13. Education level:

Non	Primary	Secondary	High school	Tertiary

14. If tertiary, please give highest qualification and subject major (eg Diploma in Crop production)……

15. Salary scale……Per annum

16. Number of members (If it's an Association)……..

17. Means of transport while executing your duties.

Vehicle	Motorbike	Foot	Other

18. How frequent are you visited by your extension Officer……

19. How frequent does your extension officer visit your farm because of the following reasons?

	Most frequently	Frequently	Less frequently	Not at all

Random visits				
Follow a pre-planned Scheduled				
On Farmer request				
When there is a challenge				
Other				

11. How accessible is your Extension Officer?

Highly accessible	Accessible	Less accessible	Not at all accessible

12. How is your relationship with your extension officer?

Excellent	better	Poor	No relationship at all

13. Please rate how comfortable would you be to be visited by an extension officer of the opposite gender?

Very comfortable	Comfortable	Less comfortable	Indifferent	Not at all comfortable

14. Please explain your response above?

……

……

……

……

15. How would you rate the literacy of the majority of your association members?

	Read only	Read and write	Cannot read and write	Speak only
English				

Siswati				

16. How many of your members have cell phones…….
17. How many use these mobile phones for sugarcane related issues? ……
18. Do you regularly use a Cell Phone? ……
19. To whom does it belong? .....
20. How frequent is it in your possession? …….
21. What is its name/brand? ……..
22. For how long have you been using it? ……
23. What type is it?

Regular phone	Smart phone

24. Where do you recharge your cell phone? ……
25. How much is your phone worth? ……Emalangeni
26. How frequent do you use your phone for the following functions?

	Most frequently	Frequently	Less frequently	Not at all
Talking				
Texting				
Pictures				
Videos				
Internet				
Radio				
Music				
Other ……				

27. Are you connected to any social media? Yes/No

28. If yes, which one?

WhatsApp	Twitter	Facebook	LinkedIn	Other

29. How frequent do you communicate with the following people using your phone on sugarcane production issues?

		Most Frequently	Less frequently	Not at all
1	Extension Agents			

2	Other Sugarcane Farmers			
3	Suppliers			
4	Financiers			
5	Researchers			
6	MTN			

30. How frequent do you use the following Facilities for purposes of information gathering and dissemination?

	Facility	Most frequently	Less frequently	Not at all	Not available
1	Radio				
2	TV				
3	Landline phone				
4	Cell phone				
5	Newspaper				
6	Magazine				
7	Fax line				
8	Computer				
9	Internet				
10	Overhead projector				
11	Printer				
12	DVD player				
13	Website				
14	Electricity				
15	Cell phone network				

31. What are the most watched channels on TVs, Radio, Newspapers and Magazines? (Put N/A where it is not available)

	TV	Radio	Newspaper	Magazine
1				
2				
3				

4				
5				
6				

32. What type of programmes/specific programmes do you watch or listen to on TV or Radio? (Put N/A where it is not available)

	TV	Radio
1		
2		
3		
4		
5		

33. Where do you get information related to sugarcane production?

	Source	Always	Rarely	Not at all
1	SSA			
2	Sugarcane famers			
3	University			
4	SWADE			
5	Government			
6	Suppliers			
7	Financiers			
8	NGOs			
9	Research institutions			
10	Libraries			
11	Internet			
12	Other…….			

34. How timely are these sources able to relay information to smallholder farmers?

	Source	Always on time	Rarely on time	Not at all on time
1	SSA			
2	Sugarcane famers			

3	University			
4	SWADE			
5	Government			
6	Suppliers			
7	Financiers			
8	NGOs			
9	Research institutions			
10	Other…….			

35. How is the information from the above sources communicated to smallholder farmers?

	Facility	Always	Rarely	Not at all
1	Radio			
2	TV			
3	Landline phone			
4	Cell phone			
5	Newspaper			
6	Magazine			
7	Fax			
8	Internet			
9	Face to face			
10	Other…….			

36. Please rate the degree of requirement for each of the following information required by smallholder farmers to improve their sugarcane productivity

	Information on:	Highly required	Rarely required	Not at all required
1	Land preparation			
2	Planting			
3	Pests and Diseases control			
4	Plant nutrition			
5	Irrigation			
6	Harvesting			
7	Postharvest operations			
8	Market information			
9	Financial information			
10	Human resource management			
11	Technology related information			
12	Economical information			
13	Weather forecast information			
12	Other……..			

BARRIERS TO ACCESSING AGRICULTURAL INFORMATION

The following statements relates to the barriers towards the adoption of agricultural information by some of the smallholder sugarcane growers. Please rate each statement with your level of agreement using the rating scale below:

1. Strongly agree (STA)
2. Slightly agree (SLA)
3. Agree (A)
4. Disagree (D)
5. Slightly disagree (SLD)
6. Strongly disagree (SD)

Item	STA	SLA	A	D	SLD	SD
Information related barriers						
1. Lack of library and information centres						
2. Lack of seminars, workshops and training programmes for smallholder farmers.						
3. Sources of information are unknown						
4. Lack of simple reading materials						
5. Lack of demonstration						
6. Unreliable information sources						
7. Poor format and unknown language presentation of sugarcane production information						
8. Information delivered not understood						
Organisation related barriers	STA	SLA	A	D	SLD	D
9. Limitation of technical support from organisations						
10. Lack of good leadership among smallholder sugarcane organisations						
11. Cultural restrictions regarding the use of ICT by women farmers						
12. Cultural restrictions regarding gender of extension officers						
13. Lack of sugarcane extension officers.						
Individual related barriers	STA	SLA	A	D	SLD	D
14. Interpersonal barriers to share among farmers						
15. Extension officers are biased						
16. Lack of awareness in availability of ICTs						
17. Lack of confidence in the ability to use ICT						
18. Lack of motivation towards using ICT						
19. Language problem towards using ICT						
20. Less preference in using ICT						
21. There is lack of skill to use ICT						
22. No time to listen to appropriate radio and television programmes on sugarcane production issues						
23. Time management problems in learning how to use ICT						
24. High illiteracy rate among smallholder farmers						
25. Untimely information delivery						
26. Lack of training availability to learn ICT						
Technology related barriers	STA	SLA	A	D	SLD	D
27. Lack of ICT equipment that can be used to disseminate information						
28. Lack of ICT infrastructure in the rural areas						
29. The cost of broadband connection is too high						

30. Low computer literacy level in the agricultural community						
31. Restricted use of available ICTs in the agricultural sector						
32. Poor interconnectivity in the rural areas						
33. Network coverage is very weak						
Policy related barriers	STA	SLA	A	D	SLD	D
34. There are no government policies and regulations about ICTs.						
35. The existing government policies and regulations about ICTs are shaky						
36. Law related to ICT policies in agricultural sector are not supported						
37. Policies in implementation that include special rate for telephone or internet for agriculture sector are not there.						
38. Budgeting in the availability of ICT in agricultural sector are limited.						

READINESS OF THE SUGARCANE PRODUCTION INDUSTRY TOWARDS THE USE OF ICT

The following statements relate to the readiness of the sugar industry stake holders towards the use of ICTs to exchange sugarcane production information. Please rate each statement with your level of agreement using the rating scale below:

1 Strongly agree (STA) 4 Disagree (D)

2 Slightly agree (SLA) 5 Slightly disagree (SLD)

3 Agree (A) 6 Strongly disagree (SD)

Items	STA	SLA	A	D	SLD	D
Farmer readiness						
1. Farmers know that ICTs can be used as a learning tool						
2. Farmers are capable of managing their time in order to use ICTs						
3. Farmers have enough skills to use ICT						
4. Farmers are ready to use ICT						
5. Access to the internet is not a problem for farmers						
Extension Officer readiness	STA	SLA	A	D	SLD	D
6. EO know how to use ICT as a teaching/learning tool						
7. ICTs are helpful in improving extension and learning						

8. This is the right time to promote the use of ICT in the sugarcane production industry						
9. EO are ready to integrate ICT utilities in their extension programmes.						
10. EO have enough ICT competency to prepare teaching/learning materials						
Infrastructure Readiness	STA	SLA	A	D	SLD	D
11. The infrastructure in the sugar industry can support ICT implementation						
12. The technical support within the industry is adequate to support ICT						
13. The sugarcane production industry can afford the budget to support the use of ICT in extension and learning.						
Management Readiness	STA	SLA	A	D	SLD	D
14. The sugarcane industry extension management knows what is ICT						
15. The sugarcane industry extension management supports the use of ICT						

Thank you

Appendix 5: Questionnare for Extension Officers

1. Name of Extension Agent…….
2. Date of interview……
3. Who is your current employer? ……..
4. Location……
5. Distance from mill……KM
4. Milling Area:

Mhlume	Simunye	BigBend

5. Language

English	Siswati	Both

6. Average Yield for last season (Under your area of responsibility …….tons/ha
7. Age……..Years
8. Gender……
9. Nationality……..
10. Sugarcane production experience……..yrs
11. Education level:

None	Primary	Secondary	High school	Tertiary

12. If tertiary, please give highest qualification and subject major (eg Diploma in Crop production)…… ……..
13. Salary scale……Per annum
14. Number of farms under your area of responsibility……..
15. Total number of sugarcane hectors under your area of responsibility …….Ha
16. Means of transport while executing your duties.

Vehicle	Motorbike	Foot	Other

17. How frequent do you visit your farmers? ……

18. How frequent do you visit your farmers because of the following reasons?

	Most frequently	Frequently	Less frequently	Not at all
Random visits				
Follow a pre-planned Scheduled				
On Farmer request				
When there is a challenge				
Other				

37. How accessible are you by your farmers?

Highly accessible	Accessible	Less accessible	Not at all accessible

38. How is your relationship with your farmers?

Excellent	Better	Poor	No relationship at all

39. Please rate how comfortable are you when visiting a famer of the opposite gender?

Very comfortable	Comfortable	Less comfortable	Indifferent	Not comfortable

40. Please explain your response above?

……

……

……

……

41. How would you rate the literacy of the majority of your sugarcane farmers?

	Read only	Read and write	Cannot read and write	Speak only
English				
Siswati				

42. How many of your farmers have cell phones? …….

43. How many use these mobile phones for sugarcane related issues? ……

44. Do you regularly use a Cell Phone? ……

45. To whom does it belong? .....

46. How frequent is it in your possession? …….

47. What is its name/brand? ……..

48. For how long have you been using it? ……

49. What type is it?

Regular phone	Smart phone

50. Where do you recharge your cell phone? ……

51. Does your area of responsibility have network coverage? ……

52. How much is your phone worth? ……Emalangeni

53. How frequent do you use your phone for the following functions?

	Most frequently	Frequently	Less frequently	Not at all
Talking				
Texting				
Pictures				
Videos				
Internet				
Radio				
Music				
Other ……..				

54. Are you connected to any social media? Yes/No

55. If yes, which one?

WhatsApp	Twitter	Facebook	LinkedIn	Other

56. How frequent do you communicate with the following people using your phone on sugarcane production issues?

		Most Frequently	Less frequently	Not at all
1	Other Extension Agents			
2	Sugarcane Farmers			
3	Suppliers			
4	Financiers			
5	Researchers			
6	MTN			

57. How frequent do you use the following Facilities for purposes of information gathering and dissemination?

	Facility	Most frequently	Less frequently	Not at all	Not available
1	Radio				
2	TV				
3	Landline phone				
4	Cell phone				
5	Newspaper				
6	Magazine				
7	Fax line				
8	Computer				
9	Internet				
10	Overhead projector				
11	Printer				
12	DVD player				
13	Website				
14	Electricity				
15	Cell phone network				

58. What are the most watched channels on TVs, Radio, Newspapers and Magazines? (Put N/A if it is not available)

	TV	Radio	Newspaper	Magazine
1				
2				
3				
4				
5				
6				

59. What type of programmes/specific programmes do you watch or listen to on TV or Radio? (Put N/A if it is not available)

	TV	Radio
1		
2		
3		
4		
5		

60. Where do you get information related to sugarcane production?

	Source	Always	Rarely	Not at all
1	SSA			
2	Sugarcane famers			
3	University			
4	SWADE			
5	Government			
6	Suppliers			
7	Financiers			
8	NGOs			
9	Research institutions			
10	Libraries			
11	Internet			
12	Other…….			

61. How timely are these sources able to relay information to smallholder farmers?

	Source	Always on time	Rarely on time	Not at all on time
1	SSA			
2	Sugarcane famers			
3	University			
4	SWADE			
5	Government			
6	Suppliers			
7	Financiers			
8	NGOs			
9	Research institutions			
10	Other…….			

62. How is the information from the above sources communicated to smallholder farmers?

	Facility	Always	Rarely	Not at all
1	Radio			
2	TV			
3	Landline phone			
4	Cell phone			
5	Newspaper			
6	Magazine			
7	Fax			
8	Internet			
9	Face to face			
10	Other…….			

63. Please rate the degree of requirement for each of the following information required by smallholder farmers to improve their sugarcane productivity

	Information on:	Highly required	Rarely required	Not at all required
1	Land preparation			
2	Planting			
3	Pests and Diseases control			
4	Plant nutrition			
5	Irrigation			
6	Harvesting			
7	Postharvest operations			
8	Market information			
9	Financial information			
10	Human resource management			
11	Technology related information			
12	Economical information			
13	Weather forecast information			
12	Other……..			

BARRIERS TO ACCESSING AGRICULTURAL INFORMATION

The following statements relates to the barriers towards the adoption of agricultural information by some of the smallholder sugarcane growers. Please rate each statement with your level of agreement using the rating scale below:

1. Strongly agree (STA)
2. Slightly agree (SLA)
3. Agree (A)
4. Disagree (D)
5. Slightly disagree (SLD)
6. Strongly disagree (SD)

Item	STA	SLA	A	D	SLD	SD
Information related barriers						
Lack of library and information centres						
Lack of seminars, workshops and training programmes for smallholder farmers.						
Sources of information are unknown						
Lack of simple reading materials						
Lack of demonstration						
Unreliable information sources						
Poor format and unknown language presentation of sugarcane production information						
Information delivered not understood						
Organisation related barriers	STA	SLA	A	D	SLD	D
Limitation of technical support from organisations						
Lack of good leadership among smallholder sugarcane organisations						
Cultural restrictions regarding the use of ICT by women farmers						
Cultural restrictions regarding gender of extension officers						
Lack of sugarcane extension officers.						
Individual related barriers	STA	SLA	A	D	SLD	D
Interpersonal barriers to share among farmers						
Extension officers are biased						
Lack of awareness in availability of ICTs						
Lack of confidence in the ability to use ICT						
Lack of motivation towards using ICT						
Language problem towards using ICT						
Less preference in using ICT						
There is lack of skill to use ICT						
No time to listen to appropriate radio and television programmes on sugarcane production issues						
Time management problems in learning how to use ICT						
High illiteracy rate among smallholder farmers						
Untimely information delivery						
Lack of training availability to learn ICT						
Technology related barriers	STA	SLA	A	D	SLD	D
Lack of ICT equipment that can be used to disseminate information						
Lack of ICT infrastructure in the rural areas						
The cost of broadband connection is too high						
Low computer literacy level in the agricultural community						
Restricted use of available ICTs in the agricultural sector						
Poor interconnectivity in the rural areas						
Network coverage is very weak						

Policy related barriers	STA	SLA	A	D	SLD	D
There are no government policies and regulations about ICTs.						
The existing government policies and regulations about ICTs are shaky						
Law related to ICT policies in agricultural sector are not supported						
Policies in implementation that include special rate for telephone or internet for agriculture sector are not there.						
Budgeting in the availability of ICT in agricultural sector are limited.						

READINESS OF THE SUGARCANE PRODUCTION INDUSTRY TOWARDS THE USE OF ICT

The following statements relate to the readiness of the sugar industry stake holders towards the use of ICTs to exchange sugarcane production information. Please rate each statement with your level of agreement using the rating scale below:

1. Strongly agree (STA)
2. Slightly agree (SLA)
3. Agree (A)
4. Disagree (D)
5. Slightly disagree (SLD)
6. Strongly disagree (SD)

Items	STA	SLA	A	D	SLD	D
Farmer readiness						
Farmers know that ICTs can be used as a learning tool						
Farmers are capable of managing their time in order to use ICTs						
Farmers have enough skills to use ICT						
Farmers are ready to use ICT						
Access to the internet is not a problem for farmers						
Extension Officer readiness	STA	SLA	A	D	SLD	D
EO know how to use ICT as a teaching/learning tool						
ICTs are helpful in improving extension and learning						
This is the right time to promote the use of ICT in the sugarcane production industry						
EO are ready to integrate ICT utilities in their extension programmes.						
EO have enough ICT competency to prepare teaching/learning materials						

Infrastructure Readiness	STA	SLA	A	D	SLD	D
The infrastructure in the sugar industry can support ICT implementation						
The technical support within the industry is adequate to support ICT						
The sugarcane production industry can afford the budget to support the use of ICT in extension and learning.						
Management Readiness	STA	SLA	A	D	SLD	D
The sugarcane industry extension management knows what is ICT						
The sugarcane industry extension management supports the use of ICT						

Thank you

Appendix 6: List of Smallholder Sugarcane Growers

1 Maplotini Farmers
2 Kwenta Akufani Investments
3 Maphobeni Farmers Association
4 Mavalela
5 Mbulane & Company
6 Ngcwaleni
7 Phendukani Investments
8 Sekuyakhona Ngoni Investment
9 Mtfweni Farmers (Pty) Limited
10 Mndobandoba Farmers Association
11 Phaphamani Farmers Association
12 M&S Investments
13 Tikane Investment
14 Mthomanzi
15 Msuthu Farmers
16 Lobovu Farmers Asociation
17 Matimavu
18 Ntengenyane Farmers Association
19 Mpondweni Investment(Pty)Ltd
20 Ziyahle Investment
21 Embusweni Mantjentima
22 Libhumane Investments
23 Ingugwane Investment
24 Vukani Farmers
25 Nconconco
26 Kusetandleni Lokuhle (Pty)Limited
27 Makhubula Farmers Limited
28 Tikhumbule Limited
29 Maphobeni Cane Growers (Pty)Limited
30 Moya Munye Investments
31 Mganyaneni Farmers Association
32 Sibhotela Investments
33 Mbabala Mngongomaneni Investments
34 Imbali Yamadlenya
35 Kuselangeni Investments
36 Kuhle Kutentela Investment (Pty) Ltd
37 Makhulusihlenga Sugarcane Farmers (Pty) Ltd
38 Chubekani Pty Limited
39 Sesibonile (Pty) Ltd
40 Qedindlala Farmers Association
41 Vuka Sive Samaja Investments
42 Nyoni Khalakahle Farmers Association
43 Ngcamphalala Khulani Investments
44 Egcekeni Farmers (Pty) Limited

45 Vulamehlo Farmers Association
46 Kuhle Kubonela Farmers Limited
47 Mnguni Investment (Farm No. 10)
48 Madlenya Irrigation Scheme
49 Mantentsaba Investments
50 Sukumani Ngonini Investments
51 Kamdalantombi Agric
52 Asibebahle Mbabala Investment
53 Indvundvundvwane Yangidzi Investment
54 Mahlobo Petros
55 Maweni Investment
56 Madvwaleni Investments (Pty) Limited
57 Setamimphilo
58 Manyovu Sugar Estate (Pty) Limited
59 Celucolo Makelane Sukati
60 Mngomezulu Thepa
61 Matsenjwa Farmers
62 Sibayesincane (Pty) Limited
63 Dlamini Daniel S
64 Nkambule Sugar Estate
65 Usuthu Mutwe (S M Tsabedze)
66 Nzama Farmers Association
67 Sukumani Bomake Farmers Association
68 Maggie G Simelane
69 Siphuwe Irrigation Scheme
70 Mhlushwa Investments (Pty) Limited
71 Dlamini J
72 Gamedze Chief Mgwagwa
73 Mabovane Farmers Association
74 Lunyangu Investments (Proprietary) Limited
75 Magagasi Bambanani Bomake
76 Jmsms Investments (Pty) Ltd
77 Vilakati Lofana
78 Makwenze Investment (Pty) Limited
79 Gwebu Mkhuzelwa
80 Dlamini Sipho L
81 Nxutsamlo Investment
82 Mbanana Farmers Association
83 Shabangu James
84 Simelane Simon M
85 Ngcamphalala Ben
86 Mngomezulu Roy V
87 Ngcamphalala Chief Mshikashika
88 Mhlabudumako Investment (Pty) Limited
89 Sarah Maziya
90 Mangcineni Investment

91 Mayikane Farmers Association
92 Shongwe Andrias M
93 Qwabe Investments (Pty) Ltd
94 Dlamini Ngudumane
95 Mahlobo Samuel
96 Mkhonta Daniel
97 Phakathi Mzimbili Zeblon
98 Ndzimandze Makhaya
99 Nhleko Nhlanhla
100 Tsabedze Mciniseli G
101 Mnisi Joseph & Vilane Betusile
102 Tsabedze Johannes M
103 Ngcamphalala M
104 Mpilimbe Farmers Association
105 Ngcamphalala Hloniphile N
106 Takhamiti Farmers Association
107 Bambanani Balimi Farmers Assoc.
108 Cathula Farmers Assoc.
109 Luzaluzile Farmers Association
110 Ekuhlamukeni Farmers Association
111 Manzana Development Assoc.
112 Hlofu Farmers Association
113 Mpetseni Farmers Co-Op
114 Phinduvele Farmers Assoc.
115 Lilanda Farmers Assoc.
116 Maphikweni Farmers Assoc.
117 Makhosazane Malambe.
118 Hhohho Cotton Growers
119 Vukasidwashini Farmers Association
120 Ingcayizivela Farmers Association
121 Phakama Mafucula Community
122 Bambanani Maliba Farmers Association
123 Intamakuphila Malibeni Association
124 Sinqobanjalo Investment (Pty) Limited
125 Ekuvinjelweni Sugar (Pty) Limited
126 Ayandza Emadvodza Farmers Association
127 Mangweni/Tingonono Farmers Association
128 Buhle Besive Multipurpose Coop
129 Calamuva Farmers Limited
130 Mthombowempilo Farmers Association
131 Madlangamphisi Farmers Company Limited
132 Mpofu Multi-Purpose Coop
133 Nhlanguyavuka Farmers Association
134 Emadvodza Ayayengana Farmers Association
135 Mabhudvu Company
136 Sivukile Farmers Association

137 Makhabeni Farmers Association
138 Lubisana Farmers Association
139 Bambanani Farmers Association
140 Nhlambane Farmers Association
141 Kwasa Dvokolwako Farmers
142 Hlomani Farmers Association
143 Ndinda Farmers Ltd.
144 Mavela Farmers Association
145 Mankontshane Farmers Association
146 Vukutimele Farmers Limited
147 Singeni Investments
148 Ntisheni Farmers Association
149 Inkululeko Yemadvodza Farmers Association
150 Khayalami
151 Mary Sukati
152 Mabiya
153 Mavula Enterprise Pty Ltd
154 Norah T. Myeni
155 Intamakuphila Farm
156 Israel S Myeni
157 C. Qwabe
158 Mhlengi Christopher Tsabedze
159 Samuel Khathwane
160 United Plantations
161 Jozlind (Pty) Ltd
162 Canterbury Estate
163 Sd/Ing
164 Nsoko Planters Limited
165 E I Ranch
166 Richmond Estate
167 Kranzicht (Farm No. 2)
168 Sinceni Farm Sugar Estate
169 Riverview (Farm No. 9)
170 Riverside Farm
171 Lomaquzu Investments
172 Gomodvo Investment (Farm No. 18)
173 Hlathikhulu Trust
174 Umtintegwa (Pty) Limited
175 Magomba Ranch / Tisuka Taka Ngwane
176 Batch Farms(Pty) Limited
177 Welanjani (Farm No. 14)
178 Kamaphiko Farm (Rem 479)
179 Hladeni Farm
180 Simms Trust (Farm No. 3)
181 Jabusisa Investments (Farm No. 20)
182 Siyobi Investment (Farm No. 8)

183 Jokovu Investment (Farm No. 16)
184 Murton Nigel
185 Mandvwambane Farms (Farm No. 17)
186 Henwood Gavin Henry
187 Dalcrue Agricultural Holdings (Pty) Ltd (Tibiyo)
188 His Majesty King Mswati Iii (Inhlanyelo Farm)
189 Umbane (Pty) Ltd
190 Makhomba Jewel (Pty) Limited
191 Tisuka Takangwane (Enthuthwini Farm)
192 Pineapple Growers Limited
193 Echibini Sugar Farm
194 Emerald Hill (Pty) Ltd
195 L.A. Hulley (Pty) Ltd
196 Etibusisweni Farm - Rssc
197 Malandela Pty) Ltd
198 Tisuka Takangwane (Avolitchi Farm)
199 Packard & Wright
200 Agriland (Pty) Ltd
201 Princess Ngebeti Dlamini
202 Ngs Investments (Pty) Ltd
203 Tinkhukhu Farms

Appendix 7: Permission for Data Collection

10/23/15

Jabulani Sifundza <jabs@ssa.co.sz>

to Mphumelelo, me, Dr, Noah, Sikhumbuzo

Dear Mbuyazwe,

It is my pleasure to advice that the CEO has granted you the permission to do the study in the sugar industry.

You will recall that in the meeting we discussed how you would go about with the survey. Among the issues discussed was the involvement of Extension Officers. You are expected to ensure their presence when you do the grower interviews. This will ensure the growers' comfort during the interviews as well as guiding you through the different locations of the grower community. The first step as discussed is to have a meetings with the Extension Officers in their respective regions to introduce the study and to ensure their cooperation. The meetings will have to be coordinated through Mphumelelo Ndlovu who was also present in the meeting we had with you.

You also undertook to bear all the costs of the survey and to share with us the results of the survey and final report. We are looking forward to these reports.

Please do not hesitate to contact my office should you have any query or when you need any other guidance on going about your study in the industry. We wish you all the best.

Regards,

Jabulani Sifundza

From: Mbuyazwe Dlamini <mzmdlamini@gmail.com>
Sent: Thursday, October 15, 2015 9:20 AM
To: Noah Dlamini
Cc: Jabulani Sifundza; Sikhumbuzo Dlamini

Mdlamini <mzmdlamini@gmail.com> 10/23/15

to Jabulani, Dr, Noah, Sikhumbuzo, Mphumelelo, Steve

This is to acknowledge receipt of permission to conduct a research within the sugar industry. We would like to convey our sincere appreciation for such an opportunity and would like to assure you that all will go as agreed in our meeting.

Regards
Mbuyazwe